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BASIC UTILITY GRAPHICS SOFTWARE FOR THE HEWLETT-PACKARD 9845B DESKTOP COMPUTER

Clare Y. Trahan
Stephen W. Jensen

U.S. DEPARTMENT OF COMMERCE
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U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

BASIC Utility Graphics Software

for a Desktop Computer

Clare Y. Trahan
Steve W. Jensen

ABSTRACT

This report describes an interactive BASIC language graphics utility program designed to facilitate easy plotting of X,Y data. The program operates on a Hewlett Packard 9845B desktop computer, in its standard configuration, and uses a Hewlett Packard 9872A four pen digital plotter. The program allows the user to view X,Y data graphically and provides a broad range of plotting options so that publication quality graphs and transparencies may be created using up to four colors on the digital plotter. Data may be digitized from a user's graph on the digital plotter, generated as a user-defined function, or input directly from the computer keyboard or magnetic tape cassette. Data may be plotted on the computer CRT, on the computer's internal thermal printer, or on the digital plotter.

KEYWORDS: BASIC; CRT; digital plotter; graphs; HP 9845B desktop computer; interactive thermal printer; magnetic cassette tape; plot; software; X,Y data.

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1. INTRODUCTION

Basic Utility Graphics Software (BUGS) is a menu-driven interactive BASIC language software package which allows up to 5,000 data points to be input, plotted and saved. It offers a broad range of media options to input, plot, and output the data. The user is guided interactively by a menu format. The program operates on a Hewlett-Packard 9845B desktop computer in its standard configuration (i.e. two tape drives, internal thermal printer, CRT graphics capabilities, and 187K of RAM with a graphics ROM). Plotter output makes use of a Hewlett-Packard 9872A digital plotter on which the following pens may be used: digitizing pen, drafting pen, and four (black, blue, red, green) felt tip or transparency pens. Output media on the digital plotter includes transparencies, drawing paper, and vellum drafting paper.

A maximum of 25 data files may be plotted at one time. The user is asked to specify the number of files to be input from each input mode; i.e., digitized, generated as a user defined function, or input directly from the computer keyboard or tape. The program then leads the user interactively through each of the input modes selected. The maximum number of points in any one file is equal to 5,000 divided by the total number of files to be input. When all files have been input, the user is taken to the Program Options Menu. Here, the user may choose to input new data, to save existing data, plot existing data, save a completed graph, retrieve a previously stored graph or to terminate the program.

When the option to plot the data is chosen the user is taken to menus to: (1) choose scale type (linear, semi-log, log); (2) enter data ranges for X and Y axes; and (3) enter title and axes labels. Four plot option menus are then presented to the user to allow modification of plotting options which are initially set to their defaults. If the option to plot data has previously been chosen the user may choose to branch directly to the fourth menu (media options).

The first menu allows the user to return to re-enter or change any of the scaling and label parameters previously entered. Also, the user may change the number of labeled major tic marks on either axis.

The second menu presents plot and dimension options. Dimension options include changing the aspect ratio of the graph; or changing the character size of the title, axes labels, or labeled major tic marks. Plot options allow the user to normalize data, plot standard deviation, plot numbers in scientific notation, place annotation in graph, and to shade any or all data files.

The third menu allows the user to choose the plot type for each data file. Available plot types are: histograms, lines, symbols, or lines and symbols. One of 10 different line types may be selected. Any ASCII character may be used for the symbol, and the symbol size may be specified. The default is to plot lines using a solid line type.

The fourth menu lists the output media. At this point the user may also return to any of the previous three option menus to change any options, or may return to the Program Options Menu. Output plotting media include the computer CRT, internal thermal printer, or the digital plotter. If annotation or standard deviation are used, they must be entered by choosing the CRT option. The printer option outputs the contents of the CRT graphic screen onto the computer's thermal printer. The plotter option takes the user to additional menus to enter the size of the plot, and the plot type to be made. Plot types include normal and publication quality color plots on drawing paper and transparencies, or the drafting pen on vellum drafting paper. If the

drafting pen is not chosen, the user is asked to specify colors for the title, axes labels, axes numbers, data files, and annotation (if used).

Since all plot options are initially set to their default values, the user need only input data files and set scaling parameters in order to generate a plot. The user's first plot, therefore, generally requires less than 10 minutes to create. As more options are selected, the plot will take more operator and plotting time. Some options, such as the size options, are harder to use than others, and will require practice in order to use them effectively. A four-color publication quality plot using all options except shading may be completed in 15 minutes by an experienced user.

Section 2 of this paper guides the user through each menu in the order that they appear in the running program. Detailed instructions are given for each menu which describe how the user is to respond to each input request and then informs the user of which menu BUGS will branch to next according to the options that he has chosen. Section 3 provides an overview of the modular structural design of BUGS which is followed by a detailed description of the key subroutines. Flowcharts for these subroutines may be found in APPENDIX D and the entire program listng is given in APPENDIX C.

The document given here is intended to serve as an example of language typical of desktop computers. To accomplish this objective requires making reference to specific equipment and instruction sets by brand name. However, no judgement as to the quality or suitability of the equipment discussed here has been made by the National Bureau of Standards, and no recommendation, favorable or otherwise, should be implied by this report.

2. USER DIRECTIONS AND MENUS

2.1 INTRODUCTION FOR THE USER DIRECTIONS

This chapter is primarily a user manual for BUGS. After setting up the system (2.3 SYSTEM SET UP), the user may plot a graph by following the instructions given in the menu descriptions. All descriptions begin with a short narrative of what the menu does and how it is implemented by the user, and is followed by step-by-step instructions on how to respond to the requested inputs as they occur on the CRT screen. A copy of the menu accompanies the instructions and is referred to in the menu description by its figure number. Each time an input is requested a "?" will appear in the bottom left corner of the screen. This is denoted in the instructions by a circled letter which corresponds to that input line, as labeled, in the corresponding figure. Data is entered or input by typing in the desired response on the keyboard (or the numeric pad to the right of the keyboard), and pressing CONT. After all inputs have been completed, the user is then informed of which menu BUGS will branch to next. All menu descriptions are denoted by the name of that menu in capital letters. The menu directions are presented in the same order that they are displayed by the program with the following exceptions: (1) 2.13 EDIT DATA menu is called by all the input menus and is therefore the last input menu listed; (2) 2.21 CHANGE TICS menu is called from the 2.22 MENU 1: INPUT PARAMETERS menu and is listed immediately before so that all menus called from MENU 1 will be listed together. Page numbers for the menus are referenced in APPENDIX C.

2.2 DATA STRUCTURE AND ORGANIZATION

Because of the limitation of the length of the tape directory (see HP Operating and Programming manual, page 206), related groups of data files may be organized into a single set made up of the files. The set is referenced on the tape by a set name of up to 6 alphanumeric characters. Associated with each set is a data set descriptor as well as data file descriptors for each file in the set. If a single data file is stored it is considered to be a data set containing one file, and it will have a set name and both a set and file descriptor. In the KEYBOARD, DIGITIZING and DEFINE FUNCTION modes, the user is asked to input a file descriptor for each file that is input.

A data set may contain up to 25 files and 5,000 data points. The maximum number of points in any one data file is equal to 5,000 divided by the total number of files in that set. An ERROR 64 (subscript out of range) will occur if in at least one file the user has tried to enter more than the maximum number of points allowed. The user must be especially careful of this in inputing data from tape.

When the data is saved on tape, all the files that have been input (since either starting the program or since the last time the input option (#1) in the 2.4 PROGRAM OPTIONS menu) are saved on the tape as a data set along with all set and file desciptors.

2.3 SYSTEM SET UP

By using the auto-start feature of the 9845B, the program will be loaded and started automatically after performing the following operations:

1) Turn the desktop computer off.
2) Insert the BUGS program tape into the RIGHT tape drive (:T15).
3) Insert a data tape into the LEFT tape drive (:T14).
4) Ensure that the AUTOST key located in the upper left of the keyboard is in.
5) Turn the computer on.
6) Turn digital plotter on. The POWER button is located at the bottom right corner of the plotter.

It is important that the program tape be loaded in the right tape drive (:T15) before turning the machine on. If the user does not wish to use the auto-start feature, skip Steps 1,4 and 5 and type LOAD "AUTOST", and press EXECUTE. When the tape drive stops, press RUN.

The 9872A digital plotter should be set up when the program is loaded. If the plotter is not turned on when it is addressed to digitize or plot a data file the following will occur : (1) A fatal error; (2) the program will be terminated; and (3) all data in the memory will be lost. The user will then have to begin the program over by pressing RUN and re-entering the data.

To set up the digital plotter:

1) Clear everything off the platten as the pen will move diagonally across the platten to its starting position.
2) Push in the power button located on the front of the plotter near the bottom right hand corner.
3) Set up felt tip pens as follows: PEN #1: BLACK PEN #3: GREEN
   PEN #2: BLUE PEN #4: RED

For directions on how to load plotting media, refer to the 2.38 DIGITAL PLOTTER menu.

2.4 PROGRAM OPTIONS

The user has access to any portion of the program through this menu. This is the main pivot point of the program, and the user will always be returned to this menu until the program is terminated by choosing option #6. See figure 2.4 for a printout of the program options.

Explanation of PROGRAM OPTIONS:

1) Input data. The new data to be input will erase from memory any data previously entered. BUGS then branches to 2.5 INPUT OPTIONS.
2) Plot data. BUGS branches to the 2.18 SCALE TYPE menu if this is the first time that this option has been chosen since starting the program; otherwise it branches to the 2.17 PLOT DATA menu.
3) Save data. BUGS branches to the 2.14 SAVE DATA menu.
4) Retrieve graph. BUGS branches to the 2.15 RETRIEVE GRAPH menu.
5) Save graph. BUGS branches to the 2.16 SAVE GRAPH menu.
6) Exit program. BUGS is terminated.

a) Enter the number which corresponds to the desired option.

If option #6 was not chosen follow the directions given in the explanation above, otherwise END OF PROGRAM will be displayed. The user may begin the program again by pressing the RUN key.

2.5 INPUT OPTIONS

In this menu BUGS is seeking user input of the number of files to be input from each input media. Input media include the computer keyboard, magnetic tape, digitizing a user's graph on the digital plotter, or generating a user defined function.

Figure 2.5 shows the printout of the narrative for the input menu. Lines a-d will be displayed one at a time, and the user is expected to input the number of files to be input from that input mode.

a-d) As each input request is made (e.g. INPUT from KEYBOARD) enter the number of files to be input from that input media, or press CONT if no files will be input from that particular input media.

If the number of files to be input is out of range (less than one or greater than 25), press CONT and wait until the menu is rewritten on the screen and repeat steps a-d.

After user entry of the number of files to be entered for each input mode, BUGS selects the appropriate modes in the sequence 2.6 KEYBOARD INPUT, 2.7 TAPE INPUT, 2.8 SET UP DIGITIZING, 2.12 DEFINE FUNCTION. Only the menus for input with nonzero number of files will be selected.

PROGRAM OPTIONS

(1) INPUT NEW DATA from keyboard, tape, digitized on digital plotter, and as a user defined function

(2) PLOT DATA on CRT, thermal printer or digital plotter

(3) SAVE DATA on tape

(4) RETRIEVE GRAPH from tape.

(5) SAVE GRAPH on tape.

(6) EXIT PROGRAM

ENTER OPTION #

Figure 2.4. PROGRAM OPTIONS.

INPUT OPTIONS

This program allows you to input up to 5000 data points. You may input a maximum of 25 data files to be plotted and/or saved on tape. The maximum number of points allowed in each data file therefore equals 5000 divided by the number of files to be input.

To start program you must input at least one data file. Data files may be input from the keyboard, tape, digitized on the digital plotter, defined as a function by the user, or any combination of these.

You will now be asked interactively to enter the number of data files that you want to be input from each input mode.

ENTER # of FILES to be INPUT from KEYBOARD
INPUT from TAPE
DIGITIZED on DIGITAL PLOTTER
FUNCTION DEFINED by USER

Figure 2.5. INPUT OPTIONS,

2.6 KEYBOARD INPUT

This input mode allows the user to input data from the computer keyboard. The user must begin by entering a file descriptor for this file and the number of points to be input. The directions on this page will be repeated for each file that the user has specified is to be input from the keyboard. The printout for this menu is figure 2.6.

See Section 2.2 for an explanation of what file descriptors are and how they are used.

a) Enter file descriptor for this file, or press CONT if no file descriptor is desired.

The menu informs the user of the maximum number of data pairs allowed for this file.

b) Enter the number of data pairs to be input

c) Enter 1 if there is a constant interval between the X values, else press CONT and go to Step g.

X values will be computed by incrementing the initial X value by the X interval every time a Y value is input.

d) Enter the first X value

e) Enter the value of the X interval

Input the Y values, one at a time, starting with the Y value which corresponds the the initial X value.

f) Input Y data values

If there is a constant X interval, skip Step g.

g) User must now input all X,Y data pairs for this file. Input X value and press CONT. Input Y value and press CONT.

The user is now taken to the 2.13 EDIT DATA menu to review and/or edit this data file.

If more files are to be input from the keyboard, repeat directions on this page for the next data file. If more files are to be input from other input modes, BUGS branches to the next input mode in the sequence 2.7 TAPE INPUT, 2.8 SET UP DIGITIZING, 2.12 DEFINE FUNCTION. Only menus for input with non-zero number of files will be selected. If no more files are to be input, BUGS branches to the 2.4 PROGRAM OPTIONS menu.

```
                INPUT FROM KEYBOARD

ENTER LABEL FOR DATA FILE # 1 ...UP TO 20 CHRACTERS                    (a)

HOW MANY DATA PAIRS ARE TO BE INPUT INTO FILE # 1 ?                    (b)
                MAXIMUM ALLOWED IS 5000

IF DATA HAS CONSTANT INTERVAL BETWEEN X VALUES...ENTER 1               (c)

INPUT FIRST VALUE FOR X  (i.e. X1(1)=?)                                (d)

INPUT THE INCREMENT BETWEEN ADJACENT X VALUES                          (e)

          INPUT Y VALUES

           INPUT #  1                                                  (f)

INPUT X VALUE...PRESS CONT...ENTER Y VALUE

          INPUT #  1                                                   (g)
```

Figure 2.6. KEYBOARD INPUT.

2.7 TAPE INPUT

This menu begins by listing the data set names contained on the tape in the left tape drive (:T14) and the user is asked to input the desired set name. The set descriptor is then displayed, along with a numbered list of the file descriptors for that set. The user then enters the corresponding number for the desired file. See Section 2.2 for an explanation of the data structure and organization; and the use of set names, set descriptors and file descriptors. Figure 2.7 contains a printout of this menu.

If the list of set names on the tape runs off of the screen, the user may scroll up and down the list by pressing the arrows in the display pad at the top center of the keyboard.

a) Enter the name of the set that is to be used...Up to 6 alphanumeric characters. The name must be one of those listed on the screen.

The set and file descriptors are then listed on the screen, and the user must choose a file to be input.

b) Enter the number which corresponds to the file to be input; or if none of these is the correct file, press CONT and return to Step a.

BUGS now branches to the 2.13 EDIT DATA menu so that the user may review and/or edit data to verify if this is the correct data file.

c) If this is not the correct file, enter 1 and go to Step e; else proceed to the next step.

If there are no more files to be input, BUGS branches to 2.4 PROGRAM OPTIONS. If there are no more files to be input from tape, BUGS branches to the next input mode.

The user now inputs the next file from the tape. The user may choose to input the file from the same set that the previous file was input from, or the user may input the file from a different set.

d) Enter 1 to use a different set for data entry and return Step a, or press CONT to get another file from this set and go to Step b.

The user now may choose to try another file from the same set that the previous file was taken from, or the user may try a different set.

e) Enter 1 to try a different set and go to Step a, or press CONT to try a different file from this set and go to Step b.

```
                    INPUT FROM TAPE

THE DATA TAPE IS ASSUMED TO BE IN THE LEFT (:T14) CASSETTE DRIVE
IF NOT THEN LOAD THE CASSETTE...PRESS CONT TO PROCEED

NAME   PRO TYPE REC/FILE  BYTES/REC   ADDRESS
T14          2

FUNKEY     KEYS       1       256         5
NEWFUN     KEYS       1       256         6
BUGS       PROG     294       256         7
MAINP      DATA     188       256       301

THIS IS A CATOLOG OF THE DATA FILES ON THE TAPE...USE THE
ARROWS IN THE DISPLAY PAD ON THE KEYBOARD TO SCROLL UP AND DOWN

INPUT THE DATA SET TO BE USED FOR FILE # 1                    (a)

                  DATA SET DISCRIPTOR IS

                  VARIABLE ENERGY IR EXAMPLE

            THE SET HAS 4 FILES ... DESCRIPTORS ARE

                     FILE # 1     5 KEV
                     FILE # 2    10 KEV
                     FILE # 3    15 KEV
                     FILE # 4    20 KEV

      INPUT the data file number you want to use for FILE # 1     (b)

                        INPUT CHECK

      IF THIS IS NOT THE CORRECT DATA FILE AND YOU WOULD LIKE

      TO TRY ANOTHER ONE ... ENTER 1                              (c)

                        GET NEXT FILE

      ENTER 0...TO PLOT ANOTHER FILE FROM THIS DATA SET

      ENTER 1...TO PLOT A FILE FROM A DIFFERENT DATA SET          (d)

       ENTER 0...TO TRY A DIFFERENT DATA FILE

       ENTER 1...TO TRY A DIFFERENT DATA SET                      (e)
```

Figure 2.7. TAPE INPUT.

2.8 SET UP DIGITIZING

To digitize files, the user is required to initialize digitizing parameters for each graph to be used by (1) digitizing the four corners of the graph, (2) entering the scale type to be used (linear, semi-log, log), and (3) entering the scale range for each axis. Since this is done once for each graph, the user enters the number of files to be input on the current graph. See figure 2.8 for a printout of the menu as it appears on the CRT screen.

Follow directions in the menu to set up the digital plotter. The user may digitize one or more files per graph.

a) Enter the number of files to be digitized from the current graph.

Follow directions to digitize the corners of the graph. Each time a corner is digitized, the computer will beep and figure 2.6b, 1-4 will be displayed one at a time for the corresponding corner.

b) Digitize corners, then press CONT when all the corners are digitized.

c) Choose a scale type by entering corresponding option number.

The user is now asked to enter the minimum and maximum values which correspond to the digitized corners of the X and Y axes. If the axis is on a log scale, powers of ten must be entered (e.g. .001,1000).

d) Enter the minimum and maximum values for the X axis separated by a comma.

e) Enter the minimum and maximum values for the Y axis separated by a comma.

The digitizing parameters for this graph are now initialized. BUGS now takes the user to the DIGITIZE FILE menu.

2.9 DIGITIZE FILE

This menu allows the user to digitize the current file. Initially, the digitizing pen is moved to the lower left corner of the plotter by the program. The user then digitizes a file by using the arrows on the digital plotter to position the digitizing pen over the point to be digitized, and pressing the ENTER key on the plotter and continuing this process until all desired data points have been digitized. The user exits the digitizing mode (thus ending the file) by pressing the P1 button on the digital plotter. The user is given an opportunity later in the program to re-digitize, add or delete points. Figure 2.9 contains a printout of the menu.

a) Enter data file descriptor. See section 2.2 for an explanation of file desriptors.

b) Digitize file by following directions given in figure 2.9.

The program now takes the user to the 2.10 DIGITIZING EDIT OPTIONS menu so the user may have an opportunity to check and/or edit the current file.

```
                        DIGITIZE

          TO SET UP PLOTTER FOR DIGITIZING:

              (1) TURN PLOTTER ON
              (2) LOAD GRAPH ANYWHERE ON PLATTEN
              (3) PUT DIGITIZING PEN INTO THE LEFTMOST PEN HOLDER

          INPUT THE NUMBER OF DIFFERENT FILES THAT
            YOU WANT TO DIGITIZE ON THIS GRAPH ?                    (a)


                      INITIALIZE GRAPH

TO DIGITIZE: Press PEN DOWN button on PLOTTER
             Position DIGITIZING PEN over point to be digitized
             Press ENTER button on PLOTTER to input the point

          (1) DIGITIZE lower left corner of graph frame

          (2) DIGITIZE upper left corner of graph frame

          (3) DIGITIZE upper right corner of graph frame

          (4) DIGITIZE lower right corner of graph frame

                      CORNER # 1  DIGITIZED
                      CORNER # 2  DIGITIZED
                      CORNER # 3  DIGITIZED
                      CORNER # 4  DIGITIZED

        PRESS  CONT  when you have DIGITIZED all four corners       (b)


                        SCALE TYPE

                  ENTER 1...IF PLOT IS LINEAR
                  ENTER 2...IF PLOT IS X-LIN, Y-LOG
                  ENTER 3...IF PLOT IS X-LOG, Y-LIN
                  ENTER 4...IF PLOT IS X-LOG, Y-LOG

      NOTE: IF YOU ARE CHOOSING A LOG AXIS, THE SCALE LIMITS
            FOR THAT AXIS MUST BE POWERS OF TEN (i.e. .01,100)    (c)


                       GRAPH RANGE

      You will now be asked to input the limits of the scales
      on each axis of the graph that you are digitizing

          INPUT THE X AXIS GRAPH LIMITS (MIN,MAX)                   (d)

          INPUT THE Y AXIS GRAPH LIMITS (MIN,MAX)                   (e)
```

Figure 2.8. SET UP DIGITIZING.

2.10 DIGITIZING EDIT OPTIONS

In this menu the user has an opportunity to check and edit the current digitized file. For edit options, see figure 2.10.

Explanation of digitizing edit options:

(1) Digitized data are plotted on the screen so that user may see what the digitized data looks like.
(2) Digitized data are printed on the thermal printer.
(3) Digitized data are edited numerically, reviewed on the screen or printed on the thermal printer.
(4) Digitized data are edited by re-digitizing points, adding points, or deleting points on the digital plotter.

When an option is chosen, BUGS will branch to the appropriate service routine and then return to this menu.

a) Enter option number desired, or press CONT to exit digitizing edit.

If option #3 is chosen, BUGS takes the user to the 2.13 EDIT DATA menu. If option #4 is chosen, BUGS takes the user to the 2.11 RE-DIGITIZING OPTIONS menu.

If more files are to be digitized from this graph, BUGS returns to 2.9 DIGITIZE FILE. If more files are to digitized from a different graph, BUGS returns to 2.8 SET UP DIGITIZING. If more files are to be input as a user defined function, BUGS branches to 2.12 DEFINE FUNCTION. If no more files are to be input, it branches to 2.4 PROGRAM OPTIONS.

2.11 RE-DIGITIZING OPTIONS

The user now has an opportunity to edit the digitized file by re-digitizing, adding or deleting points. THIS EDIT OPTION CANNOT BE USED IF THE ORIGINAL GRAPH HAS BEEN MOVED SINCE THE FILE WAS DIGITIZED. Upon selection of this option, the digitizing pen is moved by the computer immediately to the first digitized point for user comparison with the original graph. The user may then delete that point or re-digitize and add points until he chooses to let the computer move to the following digitized point or return to the 2.10 DIGITIZING EDIT OPTIONS menu. See figure 2.11 for re-digitizing options.

Directions for re-digitizing options:

1) Re-digitize a point:
   a) "RE-DIGITIZE THIS POINT NOW" is displayed.
   b) Reposition digitizing pen to the new position.
   c) Re-digitize point by pressing ENTER button on the plotter.
   d) When beep is heard, point is re-digitized.
   e) Press CONT.
2) Add a point:
   a) "DIGITIZE NEW POINT" is displayed.
   b) Follow directions in option #1 to digitize a new point.
3) Delete a point:
   a) "DATA POINT DELETED" is displayed.
   b) Press CONT.
4) Exit re-digitizing.
   a) Enter option number or press CONT to go on to the next point.

```
                    DIGITIZE FILES:

        You are allowed to DIGITIZE up to 5000 points per file
        Digitizing accuracy is generally 3%, therefore, three
        significant digits will be digitized

(1)  ENTER DESCRIPTOR for this data file...Up to 20 characters

(2)  TO DIGITIZE: Press PEN DOWN button on PLOTTER
                  Position DIGITIZING PEN over point to be digitized
                  Press ENTER button on PLOTTER to input the point

(3)  DELETE A POINT: Digitize that same point twice in a row

(4)  TO EXIT: DIGITIZING mode PRESS P1
                              PRESS ENTER


ENTER DATA DESCRIPTOR -                                              (a)
```

Figure 2.9. DIGITIZE FILES.

```
                    DIGITIZING EDIT OPTIONS

      OPTION #
        (1)   PLOT DATA on CRT

        (2)   PRINT DATA on THERMAL PRINTER

        (3)   EDIT DATA using NUMERICAL values for edit

        (4)   EDIT DATA using your original graph on DIGITAL PLOTTER


              PRESS CONT TO EXIT DIGITIZE routine and

                 return to PROGRAM OPTIONS                           (a)
```

Figure 2.10. DIGITIZING EDIT OPTIONS.

RE-DIGITIZING OPTIONS cont.

a) Enter the edit option number or press CONT to go on to the next point.

When all the points have be edited, the user is returned to the 2.10 DIGITIZING EDIT OPTIONS menu.

2.12 DEFINE FUNCTION

This input mode allows the user to input data by generating a function of one variable (X). The user is requested to input the number of data points to be generated and the minimum and the maximum X values. The X data are generated by adding an even interval (which is equal to the X data range divided by the number of points to be input) to each successive X value starting with the X minimum that is input by the user. The Y value is generated by inserting the corresponding X value into the function defined by the user. To change the program to allow for functions of more than one variable see APPENDIX B. The directions on this page are repeated for each file that the user has specified is to be input as a function. Figure 2.12 contains a printout of this menu.

a) Enter the file descriptor for this file. See Section 2.2 for an explanation of file descriptors and how they are used.

The maximum number of points allowed per file is 5000 divided by the total number of files.

b) Enter the number of points to be input into this data file.

All trigonometric functions will be computed using degrees. To change this to radians or gradians: (1) Type RAD or GRAD; (2) Press EXECUTE.

c) Enter the X minimum and maximum for the data range of the function separated by a comma.

To define the function, follow the directions in figure 2.12d.

d) Define a function of a single variable X.

The user is now taken to the 2.13 EDIT DATA menu to review and/or edit this data file.

If more files are to be defined, repeat the directions on this page for the next data file. If there are no more files to be input BUGS branches to the 2.4 PROGRAM OPTIONS menu.

RE-DIGITIZING OPTIONS

DO NOT remove GRAPH from its position on DIGITAL PLOTTER.
The DIGITIZING PEN will be stepped across GRAPH showing the points which you have DIGITIZED.

OPTION #

(1) RE-DIGITIZE A POINT

(2) ADD A POINT

(3) DELETE A POINT

(4) EXIT RE-DIGITIZING and RETURN to DIGITIZING OPTIONS

ENTER OPTION #...To go on to NEXT point PRESS CONT ⓐ

Figure 2.11. RE-DIGITIZING OPTIONS.

INPUT A FUNCTION

INPUT file DESCRIPTOR for this FUNCTION ⓐ

INPUT NUMBER OF POINTS that you want to plot for this FUNCTION...MAXIMUM number ALLOWED is 2000 ⓑ

NOTE

ALL TRIGONOMETRIC FUNCTIONS WILL BE COMPUTED IN DEGREES

INPUT the DATA RANGE for X (X MIN,X MAX) ⓒ

TO DEFINE FUNCTION:

(1) PRESS k0 Special Function Key...(upper right corner of keyboard)

(2) TYPE in function using HP format as described in the Operating and Programming Manual, Chapter 4

(3) PRESS STORE KEY...located directly above the right SHIFT KEY

PRESS CONT TO CONTINUE ⓓ

Figure 2.12. DEFINE FUNCTION.

2.13 EDIT DATA

This menu gives the user a chance to review and/or edit current data file. See figure 2.13 for the editing options.

Explanation of Edit Options:
(1) Print data pairs on the screen in groups of 18 at a time
(2) Input new X,Y values for a selected data pair
(3) Print data on thermal printer

When an editing option is chosen, BUGS will branch to the appropriate service routine and then return to this menu.

a) Enter option number or press CONT to go back to the input mode.

If selected option was number 1 or 3, a numbered list of the data will be printed; and the user repeats to Step a until CONT is pressed to return to the appropriate input menu.

For the edit data option, the user must know the number which corresponds to the data point that he desires to change.

b) Enter the number of the data pair to change.

c) Enter new data values for both X and Y, separated by a comma.

d) Enter 1 to change another data pair and go to Step b, or press CONT to exit editing and return to Step a.

```
*** OPPORTUNITY TO REVIEW AND EDIT DATA FOR FILE #1 ***

          (1) REVIEW DATA

          (2) EDIT DATA

          (3) PRINT DATA ON THERMAL PRINTER

ENTER the OPTION # that you would like to use.                    (a)

PRESS CONT TO CONTINUE ON TO NEXT FILE


                    EDIT DATA

INPUT THE # FOR THE DATA PAIR YOU WANT TO MODIFY                  (b)

X = 1    Y = 1

INPUT NEW VALUES FOR X,Y                                          (c)

TO CONTINUE EDITING ENTER 1                                       (d)
```

Figure 2.13. EDIT DATA.

2.14 SAVE DATA

The data may be stored on the magnetic tape cassette in the left tape drive (:T14). All the files that have been input either since starting the program or since last choosing the input option in the 2.4 PROGRAM OPTIONS menu are saved on the tape as a set. The user must specify a name for the set that is used to reference the data on the tape. The program then lists the file descriptors that have been input and the user is requested to supply a set descriptor for the new set. If all the files were taken from the same set, the user has the option to re-save the data into that same set. See Section 2.2 for an explanation of the data structure and organization, and figure 2.14 for a printout of this menu.

If the user chooses to save the data into the same set, BUGS destroys the data that is there and writes the new data into that set.

a) Enter 1 to store the input data back into the same data set, or press CONT to create a new set for the input data.

If the option to store data into the same set was chosen, BUGS returns to the 2.4 PROGRAM OPTIONS menu.

The data set name that is input is used to reference the the data set on the tape. The name may be up to 6 alphanumeric characters starting with a letter. Ensure that the name is not one of those already listed.

b) Enter the data set name.

c) Enter a data set descriptor...Up to 40 characters.

BUGS now returns to the 2 4 PROGRAM OPTIONS menu.

```
                    SAVE DATA ON TAPE


      IF DATA WAS INPUT FROM ONE DATA SET AND IS TO BE STORED

      IN THE SAME DATA SET...ENTER 1                                    (a)


 NOTE: IF YOU TRY TO RESTORE THE DATA FILES THAT YOU HAVE INPUT INTO
       THE SAME DATA SET THAT THEY CAME OUT OF, ANY FILES THAT WERE NOT
       INPUT FROM THAT SET WILL BE DESTROYED

NAME  PRO TYPE REC/FILE  BYTES/REC   ADDRESS
T14         2

PRO1      PROG       4       256         5
PRO2      PROG       4       256         9
PRO3      PROG       3       256        13
PRO4      PROG       2       256        16
SLIDES    DATA     831       256        18

INPUT NAME FOR THIS DATA SET...UP TO 6 CHARACTERS                       (b)


                  INPUT DATA SET DESCRIPTOR

               THERE ARE 4 DATA FILES IN THIS SET

            FILE DESCRIPTORS FOR THE DATA FILES ARE:

                    FILE #    DESCRIPTOR


                      1       5 KEV
                      2       10 KEV
                      3       15 KEV
                      4       20 KEV

      INPUT DATA DESCRIPTOR FOR DATA SET...UP TO 40 CHARACTERS          (c)
```

Figure 2.14. SAVE DATA.

2.15 RETRIEVE GRAPH

This menu allows the user to retrieve a previously stored graph. A list of the graph names as they are referenced on the tape will be displayed, and the user is asked to enter the name of the desired graph. The graph may then be plotted and revised. An example display for this menu is given in figure 2.15.

a) Enter the graph name as it appears in the list on the screen.

BUGS now branches directly to 2.35 MENU 4: OUTPUT MEDIA.

2.16 SAVE GRAPH

Completed graphs may be stored on the magnetic cassette tape in the left tape drive (:T14). The user has the option to re-store a graph into a previously created file, or create a new file. In the latter case the user must supply a new graph name that is used to reference the graph on the tape. BUGS saves the plotting parameters along with all the files used in the graph so there is no need to separately save the data files. For an example printout of this menu see figure 2.16.

If the user chooses to restore a graph into the same graph file, BUGS destroys the old graph and stores the new graph in its place.

a) Enter 1 to store a graph back into the same graph file, or press CONT to create a new graph file.

If the option to store the graph into the same data set was chosen, BUGS returns to the 2.4 PROGRAM OPTIONS menu.

b) Enter a new graph name of up to 6 alphanumeric characters. Ensure that the name is not one of those already listed.

c) Enter a graph descriptor of up to 40 chracters.

BUGS now returns to the 2.4 PROGRAM OPTIONS menu.

2.17 PLOT DATA

Since the user has already been through all the scaling parameter and plot option menus once, he now has the option to skip directly to 2.35 MENU 4: OUTPUT MEDIA and use all the parameters from the previous plot. In MENU 4 the user has access to all the other plot option menus if any changes are desired. If the user does not choose to use this option, all plot options are set to their defaults and the user must re-enter the scaling parameters. See figure 12 for a printout of this menu.

a) Enter 1 to use previously input scale parameters and plot options, or press CONT to reset all plot options to their defaults.

If the user did not choose to use the previous parameters BUGS branches to the 2.18 SCALE TYPE menu. If the user did choose to use the previous parameters BUGS branches to 2.35 MENU 4: OUTPUT MEDIA.

```
                    RETRIEVE GRAPH

NAME  PRO TYPE REC/FILE  BYTES/REC   ADDRESS
T14          2

PRO1       PROG       4       256          5
PRO2       PROG       4       256          9
PRO3       PROG       3       256         13
PRO4       PROG       2       256         16
SLIDES     DATA     831       256         18

INPUT THE FILE NAME OF THE GRAPH TO BE RETRIEVED                    (a)
```

Figure 2.15. RETRIEVE GRAPH.

```
                  SAVE GRAPH ON TAPE

IF THIS GRAPH WAS RETRIEVED FROM THE TAPE AND IS
TO BE RE-STORED INTO THAT SAME DATA FILE...ENTER 1                  (a)

NAME  PRO TYPE REC/FILE  BYTES/REC   ADDRESS
T14          2

PRO1       PROG       4       256          5
PRO2       PROG       4       256          9
PRO3       PROG       3       256         13
PRO4       PROG       2       256         16
SLIDES     DATA     831       256         18

INPUT NAME FOR THIS DATA SET...UP TO 6 CHARACTERS                   (b)

                  INPUT GRAPH DESCRIPTION

        INPUT THE NAME OF THE DATA FILE DESCRIPTOR
           FOR THIS GRAPH...UP TO 40 CHARACTERS                     (c)
```

Figure 2.16. SAVE GRAPH.

```
TO USE PLOT OPTIONS & SCALE PARAMETERS FROM
          THE PREVIOUS RUN...ENTER 1                                (a)
```

Figure 2.17. PLOT DATA.

2.18 SCALE TYPE

In this menu the user must choose linear, semi-log or log scales for the plot. The extremes of the data set will be displayed so that the user may analyze which scale type to use, i.e. if there is a very wide data range on an axis, a log scale should be chosen for that axis. See figure 2.18.

a) Enter the number that corresponds to desired scale type.

BUGS now branches to the 2.19 ENTER SCALES menu.

2.19 ENTER SCALES

In this menu the user must input the minimum and maximum values of the scale range for each axis. These values appear as the first and last numbers that are labeled on that axis. By entering values that are inside that data range, only that specific portion of the data within those values will be plotted on the graph. The printout of this menu is contained in figure 2.19.

If the axis uses a log scale, values entered must be powers of ten.

a) Enter minimum and maximum values to be used on the X axis, separated by a comma.

b) Enter minimum and maximum values to be used on the Y axis, separated by a comma.

If the 2.19 ENTER SCALES or 2.18 SCALE TYPE menus were accessed by choosing options #2 or #3 from 2.22 MENU 1: INPUT PARAMETERS, BUGS returns to the MENU 1 menu. If this is the first time BUGS has taken the user to the ENTER SCALES and/or SCALE TYPE menus since the program was started, BUGS branches to the 2.20 LABELS menu.

2.20 LABELS

In this menu the user may input a title and labels for the axes. The title may be up to 30 characters and the axes labels may be up to 20 characters. To change the length allowed for these parameters, see APPENDIX B. See figure 2.20 for the printout of this menu.

a) Enter title up to 30 characters, or enter " " to clear the title.

b) Enter label for the X axis of up to 20 characters, or enter " " to clear X axis label.

c) Enter label for the Y axis of up to 20 characters, or enter " " to clear Y axis label.

BUGS now branches to 2.22 MENU 1: INPUT PARAMETERS.

```
                INPUT SCALE TYPE

     EXTREMES of this DATA SET are...

     Xmin = 0                    Xmax = 128

     Ymin = -21.3675             Ymax = 0


     You now must CHOOSE the TYPE of graph to PLOT

          TO PLOT LINEAR ... ENTER 1
          TO PLOT X-LIN Y-LOG ... ENTER 2
          TO PLOT X-LOG Y-LIN ... ENTER 3
          TO PLOT LOG-LOG ... ENTER 4                              (a)
```

Figure 2.18. SCALE TYPE.

```
                ENTER SCALE FOR X AXIS

     X COORDINATE RANGE:  0  TO  128

     ENTER the MINIMUM and MAXIMUM values for the X AXIS          (a)

                ENTER SCALE FOR Y AXIS


     Y COORDINATE RANGE: -21.3675  TO  0

     ENTER the MINIMUM and MAXIMUM values for the Y AXIS          (b)
```

Figure 2.19. ENTER SCALES.

```
              INPUT TITLE AND AXES LABELS

       INPUT TITLE FOR PLOT...UP TO 30 CHARACTERS                 (a)
       INPUT LABEL FOR THE X AXIS...UP TO 20 CHARACTERS           (b)
       INPUT LABEL FOR THE Y AXIS...UP TO 20 CHARACTERS           (c)

 PRESS CONT TO CONTINUE
```

Figure 2.20. LABELS.

2.21 CHANGE TICKS

This menu allows the user to change the number of labeled major tic marks on a linear axis. After the data range for the axis is displayed the user is asked to input the number of major tics that divides most evenly into the range. The range is equal to the difference in the maximum and minimum values that were input for each axis in the 2.19 ENTER SCALES menu. To change the range the user must return to the MENU 1 menu and choose option #3. Log axes are set automatically by the program and cannot be changed. The printout of this menu is contained in figure 2.21.

NOTE: Using default size for numbers, there should be no more than 8 major tics on the X axis, and no more than 6 characters per number (including minus sign and decimal point) on either axis.

If the scale type chosen was not log-log skip Step a.

a) If the user has chosen a log-log scale in the 2.18 SCALE TYPE menu, the number of labelled major tic marks is set automatically. Press CONT and BUGS will return to 2.22 MENU 1: INPUT PARAMETERS.

The range that is displayed is equal to the difference between maximum and minimum values that were entered in 2.19 ENTER SCALES.

If the X axis is using a log scale, skip to Step d.

b) Input the number of major tics that will divide most evenly into the X range.

c) Enter 1 to try a different number of tics and go to Step b, or press CONT.

If Y is on a log scale, BUGS returns to 2.22 MENU 1: INPUT PARAMETERS.

d) Input the number of major tics that will divide most evenly into the Y range.

e) Enter 1 to try a different number of tics and go to Step d, or press CONT.

BUGS now returns to 2.22 MENU 1: INPUT PARAMETERS.

```
                CHANGE TICK INTERVALS

YOU MAY CHANGE THE NUMBER OF MAJOR TICK INTERVALS

                FOR LINEAR AXES ONLY

                PRESS CONT TO CONTINUE                          (a)


              X AXIS MAJOR TICK INTERVAL

The RANGE that you have chosen for the X AXIS is  1

        MAJOR TICK INTERVAL = ____RANGE____
                              MAJOR TICKS

How many MAJOR TICKS do you want on X AXIS...

DEFAULT is 4                                                    (b)

X MAJOR TICK INTERVAL = .25     X MINOR TICK INTERVAL = .05

TO TRY AGAIN...ENTER 1                                          (c)


              Y AXIS MAJOR TICK INTERVAL

The RANGE that you have chosen for the Y AXIS is  1

        MAJOR TICK INTERVAL = ____RANGE____
                              MAJOR TICKS

How many MAJOR TICKS do you want on Y AXIS...

DEFAULT is 4                                                    (d)

Y MAJOR TICK INTERVAL = .25     Y MINOR TICK INTERVAL = .05

TO TRY AGAIN...ENTER 1                                          (e)
```

Figure 2.21. CHANGE TICKS.

2.22 MENU 1: INPUT PARAMETERS

This menu allows the user to change the scaling parameters and labels that were input in the 2.18 SCALE TYPE, 2.19 ENTER SCALES, and 2.20 LABELS menus. In addition the user may change the number of labeled major tic marks on either axis. If an option number is entered the program will branch to the appropriate menu and then return the user to this menu. Parameters that have been input will appear on the screen. See figure 2.22 for an example menu.

Directions for options:

1. The program branches to the 2.20 LABELS menu.
2. The program branches to the 2.18 SCALE TYPE menu.
3. The program branches to the 2.19 ENTER SCALES menu.
4. The program branches to the 2.21 CHANGE TICS menu.

Step a may be repeated until the user chooses to exit this menu.

a) Enter option number, or press CONT to exit this menu.

If this is the first time to MENU 1 since the start of the program, or if the defaults are being used, BUGS branches to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS. If this menu was selected as option #4 from 2.35 MENU 4: OUTPUT MEDIA, BUGS returns to MENU 4.

2.23 MENU 2: DIMENSIONS/PLOT OPTIONS

This menu allows the user to normalize the data, plot annotation or standard deviation, to shade any or all files, label linear axes in scientific notation, change the aspect ratio of the graph, or change the size of the title, axes labels or axes numbers. If an option number is entered the program will branch to the appropriate menu and then return the user to this menu. An example printout of this menu may be found in figure 2.23.

Directions for options:

1. The program branches to the 2.26 ANNOTATION menu.
2. The program branches to the 2.27 NORMALIZE menu.
3. The program branches to the 2.25 SCIENTIFIC NOTATION menu.
4. The program branches to the 2.24 STANDARD DEVIATION menu.
5. The program branches to the 2.28 SHADING menu.
6. The program branches to the 2.29 DIMENSIONS menu.
7. The program branches to the 2.30 TITLE SIZE menu.
8. The program branches to the 2.31 LABEL SIZE menu.
9. The program branches to the 2.32 NUMBER SIZE menu.

a) Enter option number, or press CONT to exit this menu.

The options is processed and then BUGS returns to MENU 2. Step a may be repeated until the user chooses to exit this menu.

If this is the first time to MENU 2 or defaults are being used, BUGS branches to 2.33 MENU 3: PLOT TYPES. If this menu was selected as option #5 from 2.35 MENU 4: OUTPUT MEDIA, BUGS returns to MENU 4.

```
                    MENU 1: REVIEW INPUT PARAMETERS

OPTION #
  (1)    TITLE:

         LABELS -  X AXIS:
                   Y AXIS:

  (2)    SCALE TYPE: LINEAR

  (3)    SCALE :          X MIN = 0                X MAX =  1
                          Y MIN = 0                Y MAX =  1


  (4)    MAJOR TICKS -  X AXIS:  4   MAJOR TICK INTERVALS OF  .25
                        Y AXIS:  4   MAJOR TICK INTERVALS OF  .25

TO CHANGE ANY OF THESE PARAMETERS...ENTER OPTION #

PRESS CONT TO CONTINUE                                              (a)
```

Figure 2.22. MENU 1: INPUT PARAMETERS.

```
                  MENU 2: DIMENSION/PLOT OPTIONS

          PLOT OPTIONS                          DIMENSION OPTIONS
OPTION #                                OPTION #
  (1)   ANNOTATION:  NO                   (6)   DIMENSIONS - X AXIS: 100
                                                              Y AXIS: 60
  (2)   NORMALIZE: NO                     (7)   TITLE SIZE:    1

  (3)   SCIENTIFIC NOTATION: NO           (8)   LABEL SIZE:    1

  (4)   STANDARD                         (9)   NUMBER SIZE:   1
        DEVIATION: NO

  (5)   SHADING - FILES: ELASTIC

  TO CHANGE ANY OF THESE PARAMETERS...INPUT NUMBER THAT
  CORRESPONDS TO OPTION #

PRESS CONT TO CONTINUE                                              (a)
```

Figure 2.23. MENU 2: DIMENSIONS/PLOT OPTIONS

2.24 STANDARD DEVIATION

The user may plot an error bar on the graph. The user is asked to input the numerical value of one standard deviation and the number of standard deviations to plot. Because the user must use the cursor to position the error bar on the graph, the graph must be plotted on the CRT before it is plotted on the digital plotter. See 2.36 STANDARD DEVIATION DIRECTIONS for a complete explanation of how to input the standard deviation error bar. See figure 2.24 for a printout of this menu.

a) Enter 1 to place standard deviation on the graph or press CONT to not have standard deviation plotted on the graph.

If standard deviation was not chosen, BUGS returns directly to 2.20 MENU 2: DIMENSIONS/PLOT OPTIONS.

b) Enter the numberic value for one standard deviation.

The user may plot one, two or three standard deviations.

c) Enter the number of standard deviations to plot.

BUGS now returns to the 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS menu.

2.25 SCIENTIFIC NOTATION

The user has the option to have linear axes labeled using scientific notation. Log axes will automatically be labeled as powers of ten. If the number size, the size of the X axis (see 2.29 DIMENSIONS), and the plot size are set to their defaults or larger, the Y axis label will be out of the medium plotting range. To plot the Y label, ensure that:

Number size x (X axis size/100) x Plot size <= 0.8.

Plot size is only used on the digital plotter and is always set to 1 on the CRT and the internal printer. See figure 2.25 for a printout of this menu.

a) Enter 1 to use scientific notation, or press CONT to use the standard notation.

BUGS now returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.

STANDARD DEVIATION

TO DISPLAY STD DEV ERROR BAR ON GRAPH ENTER 1 (a)

ENTER THE VALUE FOR 1 STANDARD DEVIATION (b)

ENTER THE NUMBER OF STANDARD DEVIATIONS TO PLOT...FROM 1 TO 3 (c)

Figure 2.24. STANDARD DEVIATION.

SCIENTIFIC NOTATION

User may have SCIENTIFIC NOTATION on the LINEAR AXES

LOG AXES will AUTOMATICALLY be labelled as POWERS of 10

NOTE: If SCIENTIFIC NOTATION is used on the Y AXIS, the Y AXIS LABEL will not be printed on the CRT or on the DIGITAL PLOTTER if the default NUMBER SIZE of 1 is used. To print the Y AXIS LABEL, choose a NUMBER SIZE of .8 or SMALLER. On the DIGITAL PLOTTER, the situation may also be remedied by choosing a PLOT SIZE of .8 or SMALLER.

TO USE SCIENTIFIC NOTATION ENTER 1 (a)

Figure 2.25. SCIENTIFIC NOTATION.

2.26 ANNOTATION

This menu allows the user to place annotation in the graph and choose the annotation size. Because the annotation labels will be entered on the CRT screen after the graph is plotted, the user must plot the graph on the CRT screen before plotting it on the digital plotter. See 2.37 ANNOTATION DIRECTIONS for a complete explanation of how the annotation is entered. A copy of this menu may be found in figure 2.26.

a) Enter 1 if annotation is desired in the graph, or press CONT if annotation is not desired.

If annotation is not desired BUGS returns to 2.23 MENU 2:DIMENSIONS/PLOT OPTIONS.

The default size for annotation is 1. If the user wishes to change the size of the annotation, he may do so by entering a size multiplier. For example: if the user enters 2, the annotation will be twice the size of the default; if the user enters .5, the annotation will be half the size of the default. Generally, the multiplier should be between .85 and 1.

b) Input number between 0 and 2 to multiply default size by, or press CONT to use the default size.

BUGS now returns to 2.23 MENU 2: DIEMSIONS/PLOT OPTIONS.

2.27 NORMALIZE

In this menu the user may multiply the X and/or Y values of any file by a constant. The data ranges for each file are displayed and the user is asked if any files are to be normalized. If so the user must input the file number, the normalization factor for the X values and the normalization factor for the Y values of that file. The printout for this menu is found in figure 2.27.

Steps a and b may be repeated until the user chooses to exit this menu.

a) Enter 1 to normalize a data file, or press CONT.

If no files are to be normalized BUGS returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.

The user must input a normalizing factor for both the X and Y values. If the user does not wish either X or Y values to be normalized, he may enter a one (1) as the factor.

b) Enter the file number, the X normalization factor and the Y normalization factor.

BUGS now branches back to Step a.

ANNOTATION

TO PLACE ANNOTATION ON YOUR GRAPH...ENTER 1 (a)

WARNING: If you wish to use ANNOTATION on the DIGITAL PLOTTER you must FIRST PLOT graph on the CRT

Input MULTIPLIER between 0 and 2 for the ANNOTATION CHARACTER SIZE...DEFAULT is 1 (b)

Figure 2.26. ANNOTATION.

NORMALIZE

DATA RANGES FOR FILES ARE:

FILE #	X-MIN	X-MAX	Y-MIN	Y-MAX
1	-.04	128	.04	-17.0862
2	-.04	0	.04	0

NOTE: THE NEW VALUES FOR DATA PAIRS WILL BE ROUNDED TO FOUR SIGNIFICANT DIGITS

TO NORMALIZE A DATA FILE ... ENTER 1 (a)

ENTER FILE #, MULTIPLIER FOR X DATA, MULTIPLIER FOR Y DATA (b)

Figure 2.27. NORMALIZE.

2.28 SHADING

This menu allows any or all data files to be shaded. The user will be asked if at least one file will be shaded. If so, the file descriptors are displayed one at a time and the user is asked to indicate whether that particular file is to be shaded. Figure 2.28 shows an example printout of this menu.

a) Enter 1 to shade any file, or press CONT if no files are to be shaded.

If no files are to be shaded BUGS returns to 2.23 MENU 2:DIMENSIONS/PLOT OPTIONS.

The file numbers and descriptors are now displayed one at a time. The computer beeps and displays "SHADE THIS FILE?".

b) Enter 1 to have this file shaded, or press CONT to leave file unshaded.

Repeat Step b for each file. When all files have been displayed BUGS returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.

2.29 DIMENSIONS

The user may change the aspect ratio and/or the size of the graph. The user will be asked to enter the dimensions of both the X side (horizontal) and the Y side (verticle) of the plot in pre-defined graphic units. The maximum size allowed is 120 X units by 80 Y units, which is the total area of the screen in graphic units. On the plotter, one (1) inch is approximately equal to the ten (10) graphic units. The total graphics units along one axis equals axis length times the plot size. For example: A graph that has X axis length=40, Y axis length=40, and plot size = 1 has total plotting area in inches of:

X axis: (40 x 1)/10 = 4; Y axis: (40 x 1)/10 = 4; Area: 4" x 4"

Calculate the desired plot dimensions in inches and multiply these by ten. Remember, however, that the entire graph may be scaled down by a constant in 2.39 PLOT SIZE.

a) Enter in the size of the X side in graphic units, or press CONT to use the default size.

b) Enter in the size of the Y side in graphic units, or press CONT to use the default size.

BUGS returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.

```
                    SHADING

      YOU MAY HAVE A PARTIAL FILLING OF THE SPACE
      BELOW YOUR CURVE IN THE DATA PLOT

NOTE: CHOOSING THIS WILL MEAN THAT THE PLOT WILL TAKE
      3 TIMES AS LONG

      TO CHOOSE THIS OPTION ... ENTER 1                    (a)

            FILE # - DESCRIPTOR
              1      5 KEV

   TO SHADE THIS FILE...ENTER 1 - ELSE PRESS CONT          (b)
```

Figure 2.28. SHADING.

```
                  DIMENSION PLOT

   DEFAULT SIZE FOR PLOTTING IS 100 X UNITS BY 60 Y UNITS

          ENTER SIZE FOR X AXIS...1 TO 120                 (a)

          ENTER SIZE FOR Y AXIS...1 TO 80                  (b)
```

Figure 2.29. DIMENSIONS.

2.30 TITLE SIZE

The user may change the size of the title, axes labels, or axes numbers from the default size of 1. This is done by entering a factor by which the default size will be multiplied. If the user enters a factor of two, the output of these parameters will be twice the size of the default. Likewise, if the user enters .5, the output will be half the size of the default. The labels and numbers are also automatically scaled to the length of the axis and the plot size (if the digital plotter is used), so the user must take somewhat of a trial and error approach. For examples see APPENDIX F. The printout of the TITLE SIZE, AXES LABEL SIZE and NUMBER SIZE has been combined into figure 2.30 LABEL DIMENSIONS. Listed below are some example size factors.

Example sizes:
  size=0.....Single point
  size=1-1.5...Normal size on plot
  size=2-3.....Most effective if hardcopy plot is to be 3 x 5 inches or less

Figure 2.30a LABEL DIMENSIONS is a printout of the query for the title size factor.

a) Enter a number from 0 to 3 by which the the default size will be multiplied, or press CONT to use the default size.

BUGS now returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.

2.31 LABEL SIZE

See figure 2.30b for a printout of the query in the LABEL SIZE menu. For an explanation of how the size factor is used, see 2.30 TITLE SIZE.

b) Enter a number from 0 to 3 by which the default axes label size will be multiplied, or press CONT to use the default size.

BUGS now returns to 2.23 MENU 2: DIMENSION/PLOT OPTIONS.

2.32 NUMBER SIZE

See figure 2.30c for a printout of this query in the LABEL SIZE menu. For an explanation of how the size factor is used, see 2.30 TITLE SIZE.

c) Enter a number between 0 and 3 by which the default number size will be multiplied, or press CONT to use the default.

BUGS now returns to 2.23 MENU 2: DIMENSION/PLOT OPTIONS.

TITLE SIZE

INPUT MULTIPLIER BETWEEN 0 AND 3 FOR TITLE .

DEFAULT IS 1 (a)

AXES LABEL SIZE

INPUT MULTIPLIER BETWEEN 0 AND 3 FOR X AND Y LABEL SIZE

DEFAULT IS 1 (b)

NUMBER SIZE

ENTER MULTIPLIER BETWEEN 0 AND 2...DEFAULT IS 1 (c)

Figure 2.30. LABEL DIMENSIONS.

2.33 MENU 3: PLOT TYPES

This menu displays the files, their descriptors and the plot types chosen by the user. The default type is a solid line. The user is asked if any changes are desired. If so the program branches to the 2.34 PLOT TYPES menu where the user may input a different plot type for all the files. Figure 2.33 shows an example of MENU 3 when all defaults are used; then the 2.34 PLOT TYPES menu (2.33b); and an example again of MENU 3 when options 1-4 are chosen from the 2.34 PLOT TYPES menu.

Choice of plot types are:
(1) Lines with choice of line type.
(2) Symbols with choice of symbol and symbol size.
(3) Lines and symbols.
(4) Histogram.

Step a may be repeated until the user chooses to exit this menu.

a) Enter 1 to change a plot type, or press CONT if no change is desired.

If no changes are desired the BUGS branches to 2.35 MENU 4: OUTPUT MEDIA.
If changes are desired BUGS branches to the 2.33 PLOT TYPES menu and then returns to this menu.

2.34 PLOT TYPES

In this menu the user may change the plot type of any or all files. Each file will be presented one at a time. The user may then choose to plot lines, symbols, lines and symbols, or histograms. There are 10 different line types, any ASCII character may be used as a symbol, and the symbol size may be chosen. The program returns to 2.33 MENU 3: PLOT TYPES after all files have been presented. See figure 2.33.

a) Enter the option number, or press CONT if user does not wish to change the plot type for this file.

If the plot type selected is a histogram, skip Steps b-d. If the plot type is symbols only, skip Step b.

Information on line types is on page 18 of the ROM Graphics Manual.

b) Enter the line type number, or press CONT if no change is desired.

If the plot type selected does not use symbols, skip Steps c-d.

c) Enter a new symbol, or press CONT no change is desired.

d) Enter a number to multiply the default symbol size by, or press CONT if the user does not wish to change the symbol size.

Repeat Steps a through d until plot types have been selected for all the files. After all files have been presented the program returns to 2.33 MENU 3: PLOT TYPES. The new plot types will then be displayed. See figure 2.33f.

```
                MENU 3: PLOT-TYPE OPTIONS

          FILE # 1   LINE TYPE #      1
          FILE # 2   LINE TYPE #      1
          FILE # 3   LINE TYPE #      1
          FILE # 4   LINE TYPE #      1

        TO CHANGE ANY OF THESE FILES...ENTER 1                    (a)

              PRESS CONT TO CONTINUE


             FILE   1:  5 KEV

FOR PLOTTING DATA YOU HAVE THE FOLLOWING OPTIONS...

           ENTER 0...TO PLOT LINES
           ENTER 1...TO PLOT SYMBOLS
           ENTER 2...TO PLOT BOTH LINES AND SYMBOLS
           ENTER 3...TO PLOT A HISTOGRAM-TYPE PLOT                (b)

INPUT LINE TYPE #...ref. page 18 of ROM graphics manual           (c)

ENTER THE SYMBOL TO BE USED                                       (d)

ENTER THE MULTIPLIER OF THE PRESENT CHARACTER SIZE FOR SYMBOLS     (e)



                MENU 3: PLOT-TYPE OPTIONS

          FILE # 1   LINE TYPE #      4
          FILE # 2   SYMBOL =         +
                     SYMBOL MULT =    1
          FILE # 3   LINE TYPE #      10
                     SYMBOL =         *
                     SYMBOL MULT =    .75
          FILE # 4   PLOT HISTOGRAM

        TO CHANGE ANY OF THESE FILES...ENTER 1                    (f)

              PRESS CONT TO CONTINUE
```

Figure 2.34. PLOT TYPES.

2.35 MENU 4: OUTPUT MEDIA

In this menu the user is presented with options to plot the graph on the CRT screen, internal thermal printer, or the digital plotter. Options are also given to return to any of the other option menus. After choosing any option the user is returned to this menu. If no options is chosen BUGS returns to the 2.4 PROGRAM OPTIONS menu. See Section 2.42 SPECIAL FUNTION KEYS - PLOTTING AIDS for instructions on how to use the Special Function Keys for plotting. The printout of this menu is given in figure 2.35.

Directions for options:

1. Data is plotted on the screen using all scale parameters and plot options that have been entered.
   If the user has selected annotation or standard deviation option:
   Wait until data is finished plotting.
   Press CONT.
   If the standard deviation option was chosen, BUGS branches to the 2.36 STANDARD DEVIATION DIRECTIONS menu.
   If the annotation option was chosen, BUGS branches to the 2.37 ANNOTATION DIRECTIONS menu where the annotation labels may be entered on the graph.
2. Whatever was plotted last on the screen is dumped onto the printer. If this is the first time to MENU 4 since the start of the program, the user must plot data on the screen first.
3. Data is plotted on the digital plotter using up to 4 pen colors or a drafting pen. BUGS now branches to the 2.38 DIGITAL PLOTTER menu.
4. BUGS branches to the 2.22 MENU 1: INPUT PARAMETERS menu.
5. BUGS branches to the 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS menu.
6. BUGS branches to the 2.33 MENU 3: PLOT TYPES menu.

Step a may be repeated until the user chooses to exit this menu.

a) Enter option number and follow the directions given above, or press CONT to exit plot mode and return to the 2.4 PROGRAM OPTIONS menu.

After each option has been serviced, BUGS returns the user to this menu until the user chooses to return to the 2.4 PROGRAM OPTIONS menu.

2.36 STANDARD DEVIATION DIRECTIONS

If the standard deviation option has been chosen, the sigma error bar is entered by waiting until the graph has finished plotting on the CRT; positioning the cursor to the bottom of the desired position of the error bar; and pressing CONT. The cursor is positioned by using the arrows in the display pad which is located at the top center of the computer keyboard. See figure 2.36 for the printout of this menu.

After the graph has finished plotting, press CONT.

1) Press CONT to get back to the graphics screen.
2) Position the cursor to the bottom of the desired position of the bar.
3) Press CONT.

If the annotation option was chosen, BUGS branches to the annotation menu; otherwise it returns to 2.35 MENU 4: OUTPUT MEDIA.

```
                    MENU 4: OUTPUT MEDIA

OPTION #                                    OPTION #
  (1)  CRT                                    (4)  MENU 1:INPUT PARAMETERS

  (2)  THERMAL PRINTER                        (5)  MENU 2:DIMENSIONS/OPTIONS

  (3)  DIGITAL PLOTTER                        (6)  MENU 3:PLOT TYPES


INPUT OPTION # THAT CORRESPONDS TO WHAT YOU WANT TO DO
OR PRESS CONT TO GO BACK TO PROGRAM OPTIONS                              (a)
```

Figure 2.35. MENU 4: OUTPUT MEDIA.

```
                PLOT STANDARD DEVIATION

      THE PROGRAM IS NOW READY TO PLOT THE SIGMA ERROR BAR.

      (1) PRESS CONT TO GO BACK TO THE PLOT ON THE CRT

      (2) POSITION THE CURSOR AT THE BOTTOM OF WHERE THE ERROR BAR WILL
          BE PLOTTED

      (3) PRESS CONT

      THE PROGRAM WILL THEN PLOT THE ERROR BAR ON THE CRT

      PRESS CONT TO RETURN TO MENU 4: OUTPUT MEDIA
```

Figure 2.36. STANDARD DEVIATION DIRECTIONS.

```
WE ARE NOW READY TO LET YOU PROVIDE ANNOTATION FOR THE
GRAPH WHICH YOU HAVE JUST DRAWN

POSITION THE CURSOR TO THE LEFT EDGE OF THE POSITION WHERE YOU
WANT TO START YOUR LABEL AND PRESS CONT

THE SCREEN WILL PAUSE TO THE KEYBOARD MODE AND YOU THEN ENTER
THE ANNOTATION THAT YOU WANT

CONTINUE AS MANY TIMES AS YOU WANT

TO EXIT ANNOTATION...ENTER SAME CURSOR POINT TWICE

...TO START ANNOTATION PRESS CONT
```

Figure 2.37. ANNOTATION DIRECTIONS.

2.37 ANNOTATION DIRECTIONS

If annotation has been chosen, the user may enter up to 30 annotation labels of up to 30 characters each by: (1) Positioning the cursor to the left edge of desired label position; (2) Pressing CONT to digitize that label position, (3) Entering the label from the keyboard; and (4) Pressing CONT to see the label printed on the graph. This process is repeated until user chooses to exit annotation mode by digitizing the same label position twice in a row. The cursor is positioned by using the arrows at the top center of the keyboard. See figure 2.37 for a printout of the menu.

1) Press CONT to return to the graphics display and then position the cursor to the desired position for the first letter of the label.

2) Press CONT and then enter the label of up to 30 characters from the keyboard.

3) Repeat steps 1 and 2 for all annotation labels. After the last label has been plotted, press CONT twice to exit the annotation mode.

BUGS now returns the user to 2.35 MENU 4: OUTPUT MEDIA.

2.38 DIGITAL PLOTTER

The digital plotter allows the user to create normal and publication quality plots on paper or transparencies using up to four pen colors, or using the drafting pen on vellum drafting paper. APPENDIX F contains an example of each plotting medium. For more information on the different types of pens and papers that can be used, see APPENDIX A. See figure 2.38 for digital plotter options and examples of how long each option takes to plot.

To set up the digital plotter:

1) Turn plotter on.
2) To load plotting medium:
   a) Press CHART LOAD.
   b) Place paper on platten.
   c) Press CHART HOLD.

Plot time will increase with the number of plot options used. A publication quality graph with one file using shading will require about 5 minutes.

a) Enter option number.

BUGS now takes the user to 2.39 PLOT SIZE menu.

```
                    DIGITAL PLOTTER

There are three output medium options for the digital plotter:

        OPTION #
          (1)   FELT TIP PENS - NORMAL QUALITY
          (2)   FELT TIP PENS -- PUBLICATION QUALITY
          (3)   TRANSPARENCIES
          (4)   DRAFTING PEN

Using defaults, the time it take to plot one graph using
using one data file is:

          (1) Normal Quality - about two minutes
          (2) Publication quality - twice as long
          (3) Tansparencies - twice as long
          (4) Drafting pen  - four times as long.

INPUT the OPTION # that you would like to use                    (a)
```

Figure 2.38. DIGITAL PLOTTER.

```
                    INPUT PLOT SIZE

      You now have a chance to pick the plot size

      Plot size must be a number from 0 to 1


      EXAMPLES:

           SIZE=1.00...Full plotter limits
           SIZE=0.65...Standard 8 1/2 x 11 inch page
           SIZE=0.00...Single point on the page


      INPUT PLOT SIZE ?                                          (a)
```

Figure 2.39. PLOT SIZE.

2.39 PLOT SIZE

Plot time will significantly decrease as plot size decreases from the default size of 1. The default size will plot the graph exactly as it appeared on the CRT screen. Therefore, if any part of the graph except for the far right side is plotted off the screen when plotted on the CRT (such as title, axes labels, or axes number), these parameters will also not be plotted on the digital plotter when the default size is used. To allow room to plot these parameters, choose a smaller plot size. See figure 2.39 for a printout of this menu and example plot sizes.

a) Enter plot size (number from 0 to 1).

BUGS now takes the user to the 2.40 PLOT COLORS menu if the drafting pen option was not chosen. If the drafting pen option was chosen, BUGS plots the graph, and returns the user the user to 2.35 MENU 4: OUTPUT MEDIA.

2.40 PLOT COLORS

This menu gives the user an opportunity to select colors for the plot parameters if the drafting pen option was not chosen in the 2.38 DIGITAL PLOTTER menu. The user may continue to change pen colors for any parameter until no more parameters are chosen. Choosing a pen number of 0 will cause that plot parameter not to be plotted. This is useful in plotting different data files on different transparencies for viewgraph presentations. The program then takes the user to 2.41 ANNOTATION COLORS if annotation is to be used, or plots the graph and returns the user to 2.35 MENU 4: OUTPUT MEDIA. Figure 2.40 gives an example printout for this menu.

a) Enter the number that corresponds to the parameter that is to be changed, or press CONT to exit PLOT COLORS menu.

If no parameters were changed, BUGS takes the user to 2.41 ANNOTATION COLORS if annotation is used, or returns the user to 2.35 MENU 4: OUTPUT MEDIA after the graph has been plotted.

If a file (option #4) was <u>not</u> chosen, skip Step b.

b) Enter number that corresponds to the file to be changed.

c) Enter number between 0 and 4 for the new pen color.

The user may now have the menu rewritten to see new parameter colors displayed.

d) Enter one to review new parameter colors, or press CONT to input next color option.

BUGS now returns the user to Step a. This gives the user the option to continue changing colors or to exit this menu.

```
                    PLOT COLORS

          PEN #1 - BLACK    PEN #3 - GREEN
          PEN #2 - BLUE     PEN #4 - RED


     (1) TITLE: BLACK        (2) AXES LABELS: BLACK

     (3) AXES AND TICK MARKS: BLACK

     (4) FILE #
            1  - RED: 5 KEV
            2  - BLUE: 10 KEV
            3  - GREEN: 15 KEV
            4  - RED: 20 KEV

TO CHANGE A COLOR...ENTER OPTION # - else PRESS CONT TO CONTINUE   (a)

INPUT FILE #                                                      (b)

INPUT NEW PEN #                                                   (c)

TO REVIEW NEW COLORS...ENTER 1 - PRESS CONT TO CONTINUE           (d)
```

Figure 2.40. PLOT COLORS.

```
                  ANNOTATION COLORS

          PEN #1 - BLACK    PEN #3 - GREEN
          PEN #2 - BLUE     PEN #4 - RED

          LABEL #
            1)    BLACK - CR on SI
            2)    RED   - * -  5 kev
            3)    BLUE  - + - 10 kev
            4)    GREEN - # - 20 kev
            5)    BLACK - & - 40 kev

TO CHANGE A COLOR...ENTER LABEL # - else PRESS CONT to CONTINUE    (a)

INPUT NEW PEN #                                                   (b)

TO REVEIW NEW COLORS...ENTER 1 - PRESS CONT TO CONTINUE           (c)
```

Figure 2.41. ANNOTATION COLORS.

2.41 ANNOTATION COLORS

This menu gives the user an opportunity to select colors for the annotation labels. The user may continue to change pen colors for the labels until no more labels are chosen. Figure 2.41 contains a printout for this menu.

a) Enter the number of the annotation label to change, or press CONT to exit this menu.

If user has chosen to exit this menu, BUGS will plot the graph and return to 2.35 MENU 4: OUTPUT MEDIA.

b) Enter the number for the new pen color.

The user may now have the option to have this menu rewritten to see new label colors displayed.

c) Enter 1 to reveiw new label colors, or press CONT to enter to label color.

BUGS now returns the user to Step a. This gives the user the option to continue changing colors or to exit this menu.

2.42 SPECIAL FUNCTION KEYS-PLOTTING AIDS

Before plotting a graph on the CRT or the digital plotter, the Special Functions Keys (SFK's) located in the upper right hand corner of the keyboard may be used to switch plotting parameters on and off, center the graph on the digital plotter, plot previously input annotation and standard deviation directly on the CRT to avoid having to input them each time, and have access to basic 9845 system commands at the push of button. The default is ON for all keys.

SWITCHES: The frame, tic marks, numbers, axes labels, data files, shading, annotation, and standard deviation may be switched on or off before plotting by pressing the appropriate SFK to turn the parameter on, and SHIFT SFK to turn it off. It is especially helpful when editing a single portion of the graph to turn off other parameters in order to save plotting time. It can also be used effectively in viewgraph presentations by displaying different parts of the graph serially on different transparencies.

CENTERING THE GRAPH: To center a graph on the digital plotter, the user must determine the X and Y offsets in inches and multiply this value by ten. Positive values move the graph to the right or up while negative values move it to the left or down. Once these are determined, input the X offset by pressing SFK k2, typing in the offset, and pressing CONT. The Y offset is entered the same way, using SFK k3.

PLOTTING ANNOTATION AND STANDARD DEVIATION DIRECTLY ON THE CRT: Every time the user chooses to plot on the CRT, the annotation and standard deviation must be input again. The user may avoid this and plot all previouly input

annotation and standard deviation on the screen directly by pressing SFK k1. By pressing SHIFT k1 before the CRT option is chosen in MENU 4: OUTPUT MEDIA, the user may return to the input the input mode.

BASIC 9845 SYSTEM COMMANDS: Below are listed some basic 9845 system commands which the user might find helpful. NOTE: These commands do NOT effect the running of the BUGS program.

GRAPHICS EXIT GRAPHICS	The 9845 has two CRT modes: the alphanumeric screen which presents all menus; and the graphics on screen which the graph is plotted. Any time the alphanumeric screen is displayed, the user may display the graph by pressing SFK k5 (GRAPHICS). Likewise SHIFT k5 will return the user to the alphanumeric screen, if the graphics screen is currently being displayed.
PRINTER IS 0 PRINTER IS 16	PRINTER IS 0 causes the 9845 to print on the internal thermal printer while PRINTER IS 16 causes the system to print on the CRT. Each time one of the BUGS menus is printed on the thermal printer, the sytem will skip to the top of the next page. SFK k6 will print on the printer. SFK k7 will print on the CRT.
CAT :T15 CAT :T14	The CAT statement will list the directories of the tapes in either the right (:T15) or the left (:T14) tape drives. SHIFT k7 will list :T15 while SHIFT k6 will list :T14.

SUMMARY OF KEYS:

PLOTTING SFK's

SFK		SHIFT SFK
k1	Plot annotation and standard deviation directly on CRT	Input annotation and standard deviation on CRT.
k2	Input horizontal offset	
k3	Input vertical offset	
k8	Plot frame.	No frame.
k9	Plot tic marks.	No tic marks.
k10	Plot numbers.	No number.
k11	Plot axes labels and title.	No axes labels or title.
k12	Plot all files	No files.
k13	Plot shading.	No shading.
k14	Plot annotation.	No annotation.
k15	Plot standard deviation.	No standard deviation.

FUNCTION SFK's

k5	GRAPHICS	EXIT GRAPHICS
k6	PRINTER IS Ø	CAT :T14
k7	PRINTER IS 16	CAT :T15

3.PROGRAM DESCRIPTION

3.1 INTRODUCTION TO PROGRAM DESCRIPTION

This introduction is intended to provide a broad overview of the program structure followed by a guide on the use of the subroutine descriptions.

PROGRAM PLOT (1) declares all variables, (2) takes the user to the PROGRAM OPTIONS menu to manipulate and plot data, and (3) terminates the program. The centerpoint of the program is the OPTIONS subroutine which outputs the PROGRAM OPTIONS menu and divides the program into the five basic program modes that (1) INPUT DATA, (2) SAVE DATA, (3) RETRIEVE GRAPHS, (4) SAVE GRAPHS, and (5) PLOT DATA. The INPUT DATA subroutine drives the four input modes: (1) KEYBOARD; (2) TAPE; (3) DIGITIZE; and (4) DEFINE FUNCTION. SAVE DATA and SAVE GRAPH are stand alone subroutines that save the data files and completed graphs, respectively. RETRIEVE GRAPH is also a stand alone subroutine that retrieves a previously stored graph. The PLOT DATA subroutine supervises the input of the scale parameters and plot options, and the output of the plot. It's centerpoint is the MENU_4 subroutine which presents the MENU 4: OUTPUT MEDIA menu that allows the user to choose the output media or return to any of the other plot option menus. The actual plotting is driven by the PLOT subroutine.

This program is modular in design. Each subroutine typically performs only one specific task such as initializing variables, outputing menus, computing data, or plotting the graph. The subroutine descriptions therefore begin with a statement of the function of that subroutine. A definitions of the variables follows. Some variables which occur throughout the program are given only a brief description and a reference to another subroutine description containing a more complete definition of that variable. Most subroutine descriptions include a line by line explanation of the logic. The subroutine descriptions end with a list of the subroutines that call the subroutine.

All subroutine descriptions are denoted by the subroutine name in capital letters. Menus that are output by the subroutine are denoted by the name of the menu as given in the menu instruction (Chapter 2) and their corresponding figure numbers.

Most subroutine descriptions have an accompanying flowchart which may be found in APPENDIX D. A listing of the entire program is given in APPENDIX C. APPENDIX E contains an index to all of the subroutine flowcharts, menus, and listings.

3.2 PROGRAM PLOT

FUNCTION: Input, save and plot up to 10 data files at a time for a total of 2,000 data points.

LINE #: 20: Set up COMMON and initialize variables.
30: Take the user to the PLOT OPTIONS menu and branch to the appropriate subroutines according to the user's chosen option.
40: End program.

3.3 SUBROUTINE INIT

FUNCTION:
1) Set up COMMON and initialize variables to 0 or blanks.
2) Load Special Function Key to be used in Define_function subroutine.

VARIABLES:
Defaults: Set flag to set all plot options defaults.

LINE #:
90: Trigonometric functions are computed in degrees.
100: All array subscripts will start with 1.
110-210: Set up COMMON.
220-240: Declare temporary input arrays for use in 3.6 TAPE and 3.7 DIGITIZE subroutines.
260-330: Set array strings for use in the 3.45 COLORS and 3.25 MENU_1 subroutines.
340: Set flag to set all plotting defaults.

CALLED FROM: Program 3.2 PLOT.

3.4 SUBROUTINE INPUT_DATA

FUNCTION:
1) Input the number of files to be input from each input mode, and branch to those subroutines.
2) Compute Pfile, Pts.

VARIABLES:
Log_ck: If new data are input and plotted using previous plot parameters of log or semi-log scale types, this flag will cause logs of the new data to be taken in 3.16 PLOT_DATA subprogram.
Dig_flag: Flag for 3.13 EDIT_DATA subroutine to also change temporary data arrays Xtemp and Ytemp if data is edited numerically in 3.10 DIG_OPTS subroutine.
In(1): Number of files to be input from the keyboard.
In(2): Number of files to be input from tape.
In(3): Number of files to be digitized on the digital plotter.
In(4): Number of files to be generated as a user defined fuction.
Pfile: Total number of files to be input.
Pts: Maximum number of points allowed per file.
X1(Pfile,Pts),Y1(Pfile,Pts): Short precision arrays to hold X and Y input data.
F$(Pfile): File descriptor for input data.
Npt(Pfile): Number of points in each data file.
L1: Current file number; set to 1 to start data input.

LINE #:
680-740: Set all flags for that depend on new data.
750-760: Re-dimension and initialize input arrays to full dimensions.
Re-initialize flags.
770-880: Display Figure 1 INPUT OPTIONS.
890-1000: Input number of files for each input mode.
1010-1120: Error checks.
Compute Pfile and Pts.
Re-dimension input arrays to user specifications.
1130-1160: Branch to input subroutines.

CALLED FROM: Program 3.2 PLOT.
Subroutine 3.14 OPTIONS.

3.5 SUBROUTINE KEYBOARD

FUNCTION: Input In(1) data files from the computer keyboard.

VARIABLES:
Key: Counter for the number of files that have been input from the keyboard. When Key>In(1), exit subroutine.
XØ: Initial X value if there is a constant X interval.
Dx: Value of constant X interval.
X1(L1,I),Y1(L1,I),L1,Pfile,Npt(L1),F$(L1): See 3.4 INPUT_DATA subroutine.

LINE #:
1190-1380: Output Figure 2.6a-c INPUT FROM KEYBOARD; input F$(L1),Npt(L1)
1390-1470: Output Figure 2.6f; Input X,Y data pairs if there is no constant X interval.
1480-1580: Output Figure 2.6 d,e,g; input XØ,Dx; input Y data values.
1610-1163: Input next data file.

CALLED FROM: Subroutine 3.4 INPUT_DATA.

3.6 SUBROUTINE TAPE

FUNCTION: Input In(2) data files from tape.

VARIABLES:
Tape: Counter for the number of files that have been input from the tape. When Tape > In(2), exit subroutine.
D$: Name for the data set to be input from tape.
A$: Data set descriptor for D$.
Nfile: Number of files in D$.
Ntemp(Nfile): Number of points in each file of D$.
Ftemp(Nfile): File descriptors for D$.
Xtemp(Pfile,Pts),Ytemp(Pfile,Pts): Short precision temporary data arrays to hold X and Y data from tape.
Ifile: Number of data file from the D$ data set that the user has chosen to input.

LINE #:
1650-1760: Display Figure 2.7a INPUT FROM TAPE; input D$; Compute C$.
1770-1192: Input data into temporary data arrays.
1930-2140: Display Figure 2.7b; input Ifile.
2150-2200: Put selected data file into permanent data array.
2210: Give user a chance to review data file to verify that this is the correct data file.
2200-2300: Display Figure 2.7c; input A1.
If this is the correct file (A1=0), increment tape and file counters. If Tape > In(2), return to 3.4 INPUT_DATA subroutine.
2310-2410: Display Figures 2.7d-e; input A1.
Go back to get a different data set or a different data file from current data set depending on A1.

CALLED FROM: Subroutine 3.4 INPUT_DATA.

3.7 SUBROUTINE DIGITIZE

FUNCTION: Digitize In(3) data files using the digital plotter. Each new graph is initialized by digitizing the corners, and inputting the scale type and scale ranges. The user chooses to digitize more than one file per graph, the graph need not be re-initialized. After the file is digitized into Xtemp(L1,K) and Ytemp(L1,K), the data is rotated and scaled into X1(L1,I),Y1(L1,I).

VARIABLES:
- Dig_flag: Set flag for 3.13 EDIT_DATA subroutine to change temporary data arrays Xtemp and Ytemp if digitized values are to edited numerically.
- Digitt: Counter for the number of files that have been digitized.
- Graph: Counter for the number of files that have been digitized off of the current graph.
- Gr: Number of files to be digitized from the current graph.
- Scaleck: Flag to scale data to user units.

CALLING TREE:

```
DIG_INIT: Input number of files to be input from current graph.
          Digitize corners of current graph.
          Input scale type.
          Input scale ranges for the axes.
DIGIT: Digitize data file from the current graph.
DIG_OPTS: Check and/or edit digitized file.
  DIG_SCALE: Rotate and scale digitized file.
    ROTATE: Rotate data and corners.
    RESCALE: Scale data.
    ROUND: Round data to three significant digits.
DIG_PLOT: Plot rotated unscaled temporary data file on the CRT.
EDIT_DATA: Edit data numerically and review.
HARD: Print digitized data on the thermal printer.
DIG_EDIT: Edit unscaled, unrotated digitized data by re-digitizing
          selected points.
  ROTATE_BACK: Rotate the temporaray data back to original position.
               Set Scaleck flag to rescale permanent data file.
```

CALLED FROM: Subroutine 3.4 INPUT_DATA.

3.8 SUBROUTINE DIG_INIT

FUNCTION: Digitize corners of the graph to allow rotation and scaling of the digitized data.
Input scale type.
Input scale ranges for the axes.

VARIABLES:
- Gr: Number of files to be digitized from the current graph.
- Xframe(*),Yframe(*): Digitized corners of current graph.
- Pt: Scale type.
- Xmn,Xmx,Ymn,Ymx: Scale ranges for the X and Y axes.
- Check_lgt: Test if the scale ranges that have been input for a log axis are powers of ten.

SUBROUTINE DIG_INIT cont.

LINE #:
2710-2880: Output Figure 2.8a SET UP DIGITIZING; input Gr.
2890-2960: Output Figure 2.8b.
2970-1050: Digitize corners of the current graph.
1060-3180: Output Figure 2.8c; input Pt.
3190-3460: Output Figure 2.8d-e; input Xmn,Xmx,Ymn,Ymx

CALLED FROM: Subroutine 3.9 DIGIT.

3.9 SUBROUTINE DIGIT

FUNCTION: Digitize file number L1.

VARIABLES:
K: Number of points digitized.
Xtemp,Ytemp: Temporary arrays for digitized data. See 3.7 DIGITIZE Subroutine. Data will be rotated but not scaled in these arrays.

LINE #:
3480-3600: Output Figure 2.9 DIGITIZE FILES; input F$(L1).
3610-3730: Digitize file number L1.
3650: Test to end digitizing.
3670: Test to delete a point.
3700-3410: Signal end of digitizing.

CALLED FROM: Subroutine DIGITIZE.

3.10 SUBROUTINE DIG_OPTS

FUNCTION: Scale data for permanent data array, rotate temporary data array, present digitizing edit options to the user, input the option number that the user has selected, and branch to appropriate subroutines.

VARIABLES:
Ed: Passed to the HARD subroutine to flag program to print the data on the thermal printer instead of the CRT.
Scaleck: Scale check. Counts the number of digitizing edit options that have been chosen in 3.10 DIG_OPTS. When Scaleck=1, it flags DIG_OPTS to branch to DIG_SCALE to scale digitized data to user units. By incrementing it each time an option is chosen, data is only scaled once, except to be rescaled after going to 3.11 DIG_EDIT where it has been set back to Ø.
DØ: Digitizing edit option number input by the user.

LINE #:
3750-3940: Output Figure 2.10 DIGITIZING EDIT OPTIONS; input DØ.
3880: Increment scaling flag.
3950: Scale digitized data once.
3960-3980: Branch to appropriate subroutines or return to 3.7 DIGITIZING subroutine if user did not input an option number.

CALLED FROM: Subroutine 3.7 DIGITIZING.

3.11 SUBROUTINE DIG_EDIT

FUNCTION: Let the user edit the digitized data by stepping the digitizing pen to the points that have been digitized and allowing the user to re-digitize, delete or add additional points.

VARIABLES:
- K: Number of points in file number L1.
- I: Point that is to be changed or deleted.
- I+1: Point to be added.

LINE #:
- 4770-4860: Output Figure 2.11 RE-DIGITIZING OPTIONS.
- 4870: Reset flag to scale the data.
- 4880: Rotate the data back to its original values.
- 4910: Step digitizing pen to point number I.
- 4930: Input option number.
- 4990-5020: Branch to appropriate options.
- 5030-5080: Re-digitize point I.
- 5090-5150: Delete point I by bumping down all subsequent points by 1.
- 5160-5250: Add a point by digitizing a new point and bumping all subsequent points up by 1.

CALLED FROM: Subroutine 3.10 DIG_OPTS.

3.12 SUBROUTINE DEFINE_FUNCTION

FUNCTION: Allow user to input the number of data files (stored in In(4)) by defining a function and storing it directly into the program at line 5770.

VARIABLES:
- Function: Counts the of files that have been defined. Used to flag the return to 3.4 INPUT_DATA subroutine.
- Xmnn,Xmxx: Data range for the function of X input by the user.
- Inc: Increment between X values ((Xmxx-Xmnn)/Npt(L1)).
- Start: Initial X value.

LINE #:
- 5280-5560: Output Figure 2.12a-c DEFINE FUNCTION; input FS(L1),Npt(L1),Xmxx,Xmnn
- 5570-5620: Output Figure 2.12d.
- 5630-5720: Generate data by adding a constant interval to Xmnn to get the X value, and using that X value in the user defined function to obtain the corresponding Y value.
- 5740-5750: Get the next function.
- 5770: Function that has been defined and stored by the user.

CALLED FROM: Subroutine 3.4 INPUT_DATA.

3.13 SUBROUTINE EDIT_DATA

FUNCTION: Allow the user to choose to print, review or edit file number L1, and branch to appropriate subroutine until user choosed to exit edit mode.

VARIABLES:
- Ed: Edit option number chosen by the user.
- Dig_flag: If EDIT_DATA has been called from DIG_OPTS subroutine, change temporary data files Xtemp and Ytemp also and scale them back to plotter units.
- CØ: Counter to print data on the CRT in groups of 18.

LINE #:
- 5780-5910: Display Figure 9a EDIT DATA; input Ed.
- 5920-5930: Depending on the user's choice:
  - (1) Branch to REVIEW subroutine to print on CRT.
  - (2) Branch to EDIT_IT subroutine to display Figure ; input new X and Y data values for data pair #A1.
  - (3) Branch to HARD subroutine to print on thermal printer.
- 5940: Repeat until the user choosed to exit edit mode.

CALLED FROM:
- Subroutine KEYBOARD.
- Subroutine TAPE.
- Subroutine DIGITIZE.
- Subroutine DEFINE_FUNCTION.

3.14 SUBROUTINE OPTIONS

FUNCTION: This is the main pivot point in the program. User will always be returned to this menu until option #4 is chosen. Program control will then be returned to the main program which will call a subroutine to terminate the program.

VARIABLES:
- A1: Options number input by the user.

LINE #:
- 410-540: Output Figure 2.4 PROGRAM OPTIONS; input A1.
- 550-610: Branch to subroutines or return to 3.2 PROGRAM PLOT.

CALLED FROM: 3.2 PROGRAM PLOT.

3.15 SUBROUTINE SAVE_DATA

FUNCTION: If the data were input from tape, they may be restored into the same data set on tape. If the data were input in the other modes, they may be stored into a new set on tape.

VARIABLES:
- D$: Data set name input by the user.
- A$: Data set descriptor input by the user.
- Nr: Number of records to create for the data set storage.
- Mxnpt: The largest number of points in any one file.
- Restore: Flag to store data into the same set.

LINE #:
- 6450-6520: Output Figure 2.14a SAVE DATA; input A1.
- 6530-6570: Output Figure 2.14b; input D$.
- 6570-6680: Compute Mxnpt, Nr; purge the old file; and create a new file on the tape.
- 6690-6770: Output Figure 2.14c; input A$.
- 6780-6900: Print data onto the tape.

CALLED FROM: Subroutine 3.14 OPTIONS.

3.16 SUBROUTINE PLOT_DATA

FUNCTION: Present all user with all scaling and plot options and plot on CRT, thermal printer or digital plotter.

VARIABLES:
- Defaults: Flag to set all the plot options the their defaults and to force the user to run through all the plot option menus.
- An: Flag input by the user to use the previous run's parameters. In the program it will cause the program to scale the data if a log axis is used and skip directly to MENU_4 subroutine.
- Log_ck: Flag that new data have been input. Set at the INPUT_DATA subroutine.

LINE #:
- 7950-8040: Pass the COMMON variables.
- 8050: Save the total number of files.
- 8060: If the graph was retrieved from tape, skip directly to 3.38 Menu_4.
- 8070: If Defaults is true, the plot options will be set to their defaults and the user must enter all scale options.
- 8080-8110: Output Figure 2.17 PLOT DATA menu and input An.
- 8130: Find the ranges of the data files.
- 8140-8150: If there are new data and the user wishes to plot a log scale take logarithms of the new data.
- 8170-8230: Go to all the plot option menus.

CALLED FROM: Subroutine 3.14 OPTIONS.

3.17 SUBROUTINE FIND_RANGE

FUNCTION: Find the X and Y data ranges for each file and for the entire data set.

VARIABLES:
   X_min(*),X_max(*),Y_min(*),Y_max(*): Data ranges for each file to be used in 3.34 NORMALIZE subroutine.
   Xmin,Xmax,Ymin,Ymax: Data ranges for entire data set to be used in 3.21 SCALE_TYPE and 3.22 ENTER_SCALES subroutines.

CALLED FROM:
   Subprogram 3.16 PLOT_DATA.
   Subroutine 3.21 SCALE_TYPE.
   Subroutine 3.34 NORMALIZE.

3.18 SUBROUTINE SET_DEFAULTS

FUNCTION: Set all plot options to their defaults and set Default flag to false.

CALLED FROM: Subprogram 3.16 PLOT_DATA.

3.19 SUBROUTINES X_LIN_TO_LOG and Y_LIN_TO_LOG

FUNCTION: Scale the data set from user input form to graphing form.

CALLED FROM:
   Subprogram 3.16 PLOT_DATA.
   Subroutine 3.21 SCALE_TYPE.

3.20 SUBROUTINES X_LOG_TO_LIN and Y_LOG_TO_LIN

FUNCTION: Scale data set back from graphing form to user input form.

CALLED FROM: Subroutine 3.21 SCALE_TYPE.

3.21 SUBROUTINE SCALE_TYPE

FUNCTION:
   1) Convert data to and from plotting units if log or semi-log scale types were chosen by the user.
   2) Input scale type.
   3) Branch to 3.22 ENTER_SCALES subroutine to input X and Y scale range.

VARIABLES:
   Pt: Scale type input by the user.

SUBROUTINE SCALE_TYPE cont.

LINE #:
9090-9110: Convert data from log form to linear form if previous scale type chosen was log for either axis.
9120: Find ranges for the data set.
9130-9510: Output Figure 2.18 SCALE TYPE menu; input Pt.
9520-9530: Convert data to log form for log axes.
9550: Get new scale ranges.

CALLED FROM: Subprogram 3.16 PLOT_DATA.
Subroutine 3.25 MENU_1.

3.22 SUBROUTINE ENTER_SCALES

FUNCTION: Input scale ranges for the X and Y axes.

VARIABLES:
Xmn,Xmx,Ymn,Ymx: Values input by the user for the X and Y axis scaling ranges.
Nx,Ny: Distance between minor tics on the linear axes, or the number of major tics on the log axes.
Xm,Ym: Number of major ticks.
Xt,Yt: Value of the minor tics in user units on linear axes.
Dmin,Dmax: Check if input values for log axes are powers of ten.

LINE #:
9570-9590: Output Figure 2.19a ENTER SCALES.
9610-9830: Enter Xmn,Xmx for log axis.
9850-9930: Enter Xmn,Xmx for linear axis.
9940-9960: Output Figure 2.19b.
9980-10180: Enter Ymn,Ymx for log axis.
10200-10280: Enter Ymn,Ymx for linear axis.

CALLED FROM:
Subroutine 3.21 SCALE_TYPE.
Subroutine 3.25 MENU_1.

3.23 SUBROUTINE LABELS

FUNCTION: Input title and axes labels for the plot.

VARIABLES:
TS: Title.
XS: X axis label.
YS: Y axis label.

CALLED FROM:
Subprogram 3.16 PLOT_DATA.
Subroutine 3.25 MENU_1.

3.24 SUBROUTINE TIC_COUNT

FUNCTION:
1) Input the number of labelled major tics.
2) Compute new X and Y minor tics (Xt,Yt) in user units.

VARIABLES:
Xm,Ym: Number of major tics input by user.
Xt,Yt: minor tic values in user units.

LINE #:
10420-10470: Output Figure 2.21a CHANGE TICS.
10490-10580: Output Figure 2.21b.
Input Xm.
Compute Xt,Nx.
10590-10650: Output Figure 2.21c; input A1.
10680-10770: Output Figure 2.21d.
Input Ym.
Compute Yt,Ny.
10780-10830: Output Figure 2.21e; input A1.

CALLED FROM: Subroutine 3.25 MENU_1.

3.25 SUBROUTINE MENU_1

FUNCTION: Branch to subroutines that corresponds to option number chosen by the user until no option is chosen (A1=0).

VARIABLES:
A1: Option number input by the user.

CALLED FROM:
Subprogram 3.16 PLOT_DATA.
Subroutine 3.38 MENU_4.

3.26 SUBROUTINE MENU_2

FUNCTION: Branch to subroutine that corresponds to the option number input by the user until no option is chosen (A1=0).

VARIABLES:
A1: Option number input by the user.

CALLED FROM:
Subprogram 3.16 PLOT_DATA.
Subroutine 3.38 MENU_4.

3.27 SUBROUTINE STD_DEV

FUNCTION: Output the 2.24 STANDARD_DEVIATION menu, input the standard deviation flag; and if standard deviation is used, input the value of one standard deviation and the number of standard deviations to plot.

VARIABLES:
- Sd: Input flag to plot standard_deviation.
- Num_sd: Number of standard deviations to plot.
- Std: Value of one standard deviation.

CALLED FROM: Subroutine 3.26 MENU_2.

3.28 SUBROUTINE SCI_NOT

FUNCTION: Output the 3.25 SCIENTIFIC NOTATION menu, and input the flag to use scientific notation.

VARIABLES:
- Sci_not: Flag to plot scientific notation.

CALLED FROM: Subroutine 3.26 MENU_2.

3.29 SUBROUTINE TITLE_SIZE

FUNCTION: Output the figure 2.30 TITLE SIZE menu and input Tsize. Tsize will be used in the LABEL subroutine which is called from the PLOT subroutine.

VARIABLES:
- Tsize: Character size multiplier for the title.

CALLED FROM: Subroutine 3.26 MENU_2.

3.30 SUBROUTINE LABEL_SIZE

FUNCTION: Output the figure 2.31 LABEL SIZE menu and input Lsize. Lsize will be used in the LABEL subroutine which is called from PLOT subroutine.

VARIABLES:
- Lsize: Character size multiplier for the X and Y axes labels.

CALLED FROM: Subroutine 3.26 MENU_2.

3.31 SUBROUTINE NUMBER_SIZE

FUNCTION: Output the figure 2.32 NUMBER SIZE menu and input Nsize. Nsize will be used in the NUMBER subroutine which is called from PLOT subroutine.

VARIABLES:
- NSize: Character size multiplier for the labels for the major tics on the X and Y axes.

CALLED FROM: 3.26 MENU_2.

3.32 SUBROUTINE DIMENSIONS

FUNCTION: Reset
plot aspect ratios to their defaults, output 2.29 DIMENSIONS menu and input sizes.

VARIABLES:
Xsize,Ysize: Length of horizontal and vertical sides of the graph in graphic units.

CALLED FROM: 3.26 MENU_2.

3.33 SUBROUTINE ANNOTATION

FUNCTION: Output 2.26 ANNOTATION menu, input annotation flag and input annotation size if annotation is to be used.

VARIABLES:
Annot: Flag use annotation in graph.
Asize: Character size multiplier for annotation.

CALLED FROM: 3.26 MENU_2.

3.34 SUBROUTINE NORMALIZE

FUNCTION: If data are normalized, set flag and normalize the selected data file.

VARIABLES:
X_min(L1),X_max(L1),Y_min(L1),Y_max(L1): Data ranges for file number L1.
X_min$(L1),X_max$(L1),Y_min$(L1),Y_max$(L1): Character values of the data ranges for file number L1.
Norm: Flag that a file has been normalized.
Xmult,Ymult: Multipliers for the X and Y data values.
File: File number to be normalized.

LINE #:
12300-12470: Output Figure 2.27 NORMALIZE; input A1.
12490: Set normalize flag.
12500: Input File, Xmult, Ymult.
12510-12590: Normalize data file number File.
12600-12590: Set display string for use in 3.26 MENU_2.
12700: Find new values for the data ranges.

CALLED FROM: 3.26 MENU_2.

3.35 SUBROUTINE SHADING

FUNCTION: Input flag if a data file is to be shaded and if so input which data files are to be shaded.

VARIABLES:
- Shade: Flag if any data file is to be shaded.
- Shade(L1): Flag to shade file number L1. Used in PLOT subroutine.
- Shade$(L1): Print character for L1 in 3.26 MENU_2.
- L1$: Print L1 as a character in the 3.35 SHADING menu.

LINE #:
- 12760-12830: Output Figure 3.35a SHADING; input Shade.
- 12860-12940: Output Figure 3.35b; input shade flags for each file.
- 12950-13040: Set output string for use in Menu_2
- 12950-13040: Set up output string for use in 3.26 MENU_2.

CALLED FROM: 3.26 MENU_2.

3.36 SUBROUTINE MENU_3

FUNCTION: Output 2.33a MENU 3: PLOT TYPES and input A1. Branch to 3.37 PLOT_TYPES subroutine until user chooses to exit this menu (A1=0).

VARIABLES:
- A1: Flag to change plot types.

CALLED FROM:
- Subprogram 3.16 PLOT_DATA.
- Subroutine 3.38 MENU_4.

3.37 SUBROUTINE PLOT_TYPES

FUNCTION: Output 2.33b PLOT TYPES menu for each file and input new plot type and line type, symbol and symbol size, if used.

VARIABLES:
- P1(L1): Plot type for file number L1. Used in PLOT subroutine.
- Lt(L1): Line type for file number L1. Used in LINES subroutine which is called from PLOT subroutine.
- L$(L1): Symbol for file number L1. Used in SYMBOLS subroutine which is called from PLOT subroutine.
- Cm(L1): Symbol size for file number L1.

CALLED FROM: 3.36 MENU_3.

3.38 SUBROUTINE MENU_4

FUNCTION: Branch to subroutine that correspond to the option number entered by the user from 2.35 MENU 4: OUTPUT MEDIA menu until no option is chosen (A1=0). The user has options to plot data on the CRT, thermal printer and digital plotter or the user may return to any of the other three options menus.

VARIABLES:
A1: Option number

CALLED FROM: 3.16 PLOT_DATA.

3.39 SUBROUTINE CRT

FUNCTION: Set plotting variables to the CRT defaults and plot data on the CRT.

VARIABLES:
S: Set the size of the plot to the size of the CRT.
Xdp,Ydp: Set plotting offsets to 0. Used in PLOT subroutine to center the graph on the digital plotter platten.

CALLED FROM: 3.38 MENU_4.

3.40 SUBROUTINE PRINTER

FUNCTION: Dump whatever is on the graphics CRT onto the thermal printer.

CALLED FROM: 3.38 MENU_4.

3.41 SUBROUTINE STAN_DEV

FUNCTION: If the PLOT subroutine is called from the CRT subroutine, this subroutine allows the user to digitize the bottom of the desired position of the error bar. However, if PLOT was called from the PLOTTER subroutine, the error bar is plotted where the last error bar position was digitized.

VARIABLES:
Sdx,Sdy: Coordinates for the digitized position of the error bar.
Nsd_gu: Length of the error bar in graphic units.
Num_sd: The number of standard deviation ot plot. Input in the 3.27 STD_DEV subroutine.
Nsd: Value of one standard deviation. Input in the 3.27 STD_DEV subroutine.

LINE #:
18240-18320: Output 2.36 STANDARD DEVIATION DIRECTIONS menu.
18330-18350: Set cursor on screen; digitize position; find length of bar.
18360-18410: Draw the error bar.
18420-18510: Draw plus or minus the number of standard deviations.

CALLED FROM: Subroutine PLOT.

3.42 SUBROUTINE ANNOTATE

FUNCTION: If called from the CRT subroutine, user is allowed to enter up to thirty annotation labels by digitizing the point where the annotation is to be labeled and then entering the annotation label from the keyboard. The user signals the end of the annotation by digitizing the same point twice. If called from the PLOTTER subroutine, the annotation will be plotted where it was last entered from the CRT.

VARIABLES:

L: Subscript for the annotation array.
Ann: Number of labels input. Used in 3.45 COLORS to input colors for the annotation labels.
Xa(L),Ya(L): X,Y coordinate of the first letter of annotation label number L.
Asize: Character size multiplier for the annotation. It is input by the user in the ANNOTATION subroutine.

LOGIC:

Output 3.37 ANNOTATION DIRECTIONS menu.

Until user chooses to stop inputting annotation, set a loop to:
a) Digitize position for the label.
b) Input labels from the keyboard (Plabel$(L)).
c) Write the label on the CRT.
d) Exit loop when the same point is digitized twice i.e. Xa(L-1)=Xa(L) and Ya(L-1)=Ya(L).

If plotting on the digital plotter;
a) Pick pen for label.
b) Skip everything but the labeling in line #15670.

LINE #:

18580-18660: Output Figure 3.37 ANNOTATION DIRECTIONS menu.
18690: Put cursor on the CRT screen.
18720&18760: Test to exit annotation loop.
18740: Digitize label position on the CRT.
18780-18850: Label the annotation.

CALLED FROM:

3.39 CRT.
Subroutine PLOTTER.

3.43 SUBROUTINE PLOTTER_MENU

FUNCTION: Output 2.38 DIGITAL PLOTTER menu for the digital plotter, input the output media chosen by the user and branch to the appropriate subroutine.

VARAIBLES:
Do: Input option number.

CALLED FROM: Subroutine PLOTTER.

3.44 SUBROUTINE SIZE

FUNCTION: Output 2.39 PLOT SIZE menu, input plot size, and compute plotting offsets Xdp and Ydp.

VARIABLES:
S: Plot size input by the user.
Xdp,Ydp: Offsets to center the graph on the platten.

CALLED FROM: Subroutine PLOTTER.

3.45 SUBROUTINE COLORS

FUNCTION: Output 2.40 PLOT COLORS and 2.41 ANNOTATION COLORS menus. Input option number to change color, file number (if needed), and new pen number until user choosed to go to next menu or plot the data by not choosing an option number (A1=0).

VARIABLES:
Pen$: BLACK,BLUE,GREEN,RED color array.
Pc1: Color for axes, standard deviation and tic marks.
Pc2(L1): Color for file number L1.
Pc3: Color for the title.
Pc4: Color for the axes labels.
Op: Option number input by the user.
Fil: File number to be changed if option number 4 was chosen.
P: New pen number.
Annot: Flag to go to the annotation menu if annotation is used.
Ann-1: Number of annotation labels.
Plabel$: Array of annotation labels.

CALLED FROM: Subroutine PLOTTER.

APPENDIX A: MATERIALS

APPENDIX A: MATERIALS

This appendix contains tips on the output media materials that may be used on the internal thermal printer and/or the digital plotter. The appendix is broken up into sections describing the (1) paper; (2) pens; and (3) miscellaneous materials. Each section begins with a description on the best use of each material followed by a list of these materials that contains a description of the material, the order number, and the quantity per order.

Section 1: PAPER

INTERNAL THERMAL PRINTER: Hewlett Packard produces two types of thermal paper: (1) continuous roll; and (2) perforated 8.5 x 11 inch roll with black print. One graph using all the size defaults uses two-thirds of an 8.5 x 11 inch page. If the perforated paper is used and the TOP OF FORM button on the 9845 is not pressed after one graph, the next graph will be plotted over the perforation leaving a one inch gap in the graph. For this reason the continuous paper is the one recommended.

DESCRIPTION	ORDER #	QUANTITY
HP continuous blue print thermal paper	92161R	6 rolls
HP perforated Page-Perf high contrast black print thermal paper	92161D	6 rolls

DIGITAL PLOTTER:

PLOTTING WITH FELT TIP PENS: The drawing paper is a medium weight cotton fiber paper that definitely produces the best results. It yields a clear solid line and does not darken or wrinkle easily. If slides of plots are to be made, this is the only paper recommended.

Thermal paper may also be used. It yields a bright, clear line, but darkens and wrinkles easily. However, it is a good idea to use this as scrap paper for trial plots before plotting on the more expensive paper or transparencies.

PLOTTING WITH THE DRAFTING PEN: The drafting pen can be used on almost any kind of paper, but the vellum drafting paper yields the most pleasing results.

PLOTTING TRANPARENCIES: By far the best transparency film used so far is made by Hewlett Packard as it does not smear.

PLOTTING WITH SPECTRUM PENS: The Spectrum Graphics Kit is new from Hewlett Packard. The kit contains subtractive ink pens, i.e., pens that blend their colors together as they overwrite each other. It is definitely recommended to use spectrum paper with the spectrum pens. The inks will blend on different types of paper; but they

appear dark and mixing more than two colors generally produces black. The stacked bar chart effect in Figure 7 of APPENDIX F was created by assigning a different color to each file and shading.

DESCRIPTION	ORDER #	QUANTITY
Transparencies	9270-0639	100 8.5"x11" sheets
Spectrum Paper	9280-0516	100 8.5"x11" sheets

Section 2: PENS

FELT TIP PENS: The Hewlett Packard felt tip pens for the digital plotter come in regular tip (0.3 mm) and broad tip (0.7 mm). Regular tip pens work well for everything but should especially be used if the plot size is less than 0.65. The broad tip pens are good for (1) paper that doesn't absorb ink well (such as the vellum) (2) making numbers, title and axes labels stand out more; and (3) making the shading completely solid.

TRANPARENCY PENS: Hewlett Packard transparency pens should be used on the Hewlett Packard transparency film. Felt tip pens should not be used on the tranparency film because it smears badly. The transparency pens also come in two tip widths and are used in the same way as the felt tip pens. If the program is being used to make viewgraphs, the broad tip pens should be used.

DRAFTING PEN: The Hewlett Packard liquid ink drafting pen is the only satisfactory drafting pen that has been tried so far. It is used just as the felt tip pens are; however, because it is bigger, the user must be careful that the plotter does not try to put the pen away into one of the pen stables as this can cause considerable damage to the plotter.

SPECTRUM PENS: Hewlett Packard claims that the new subtractive ink pens can create up to 100 different colors. They work especially well for large shaded areas. There are only 12 distinct colors that may be created, while the other 90 rely on adding differing concentrations of dots on another color, causing the eye to blend them together into another slightly different shade. Figure 7 in APPENDIX F shows the three primary colors (yellow, magenta, and cyan) and the intermediate colors produced by mixing 2 colors together. Care should be taken when using these pens that the pens stables have been cleaned out carefully with a cotton tipped swab, and they should not be used in conjuction with the regular felt tip pens.

DESCRIPTION	ORDER #	QUANTITY
Narrow tip felt tip plotting pens	5060-6810	1 pack of 4 colors (black. blue, red, green)
Wide tip felt tip plotting pens	5060-6858	1 pack of 4 colors (black, blue, red, green)

DESCRIPTION	ORDER #	QUANTITY
Narrow tip transparency plotting pens	5060-6818	1 pack of 4 colors (black, blue, red, green)
Wide tip transparency plotting pens	5060-6819	1 pack of 4 colors (black, blue, red, green)
Drafting pen body	07580-60025	Each
Narrow drafting pen tip	9200-0588	Each
Wide drafting pen tip	9260-0579	Each
Drafting pen caps	4320-0365	Each
Spectrum plotting pens	5060-6855	1 pack of 4 colors (black, blue, red, green)

Section 3: MISCELLANEOUS

TAPES: The only storage medium used by this program is the magnetic minicassette tapes that may be ordered from Hewlett Packard.

KITS: Hewlett Packard provides a transparency kit and a spectrum graphics kit. Thc transparency kit contains 200 sheets of transparency film, a 1 ounce bottle of ink solvent, and one package each of blue, black, red, green; and violet, gold, orange, and black pens in broad and regular tips. The spectrum graphics kit contains 100 sheets of spectrum paper and four packages of spectrum pens. These kits do not save any money but they are more convenient to order.

DESCRIPTION	ORDER #	QUANTITY
HP magnetic mini-cassette tapes	98200A	Box of 5
Spectrum Graphics Kit	9872-60069	Each
Transparency	17055A	Each

APPENDIX B: MODIFICATIONS

APPENDIX B: MODIFICATIONS

In using BUGS, there are occasions which require changes to be made in the program to accommodate a particular graph. Below are listed some changes that have been needed most frequently.

I. A line of the program may be changed by:
   1) Pressing the STOP key to the right of the alphnumeric keyboard.
   2) Typing EDITLINE and the number of the line to be changed.
   3) Pressing EXECUTE.
   4) Typing in the desired change, using the arrows in the display pad to move the cursor.
   5) Pressing the STORE key located directly above the right SHIFT key.
   6) Pressing the RUN key located beneath the STOP key to begin the program over.
   7) BUGS may be changed permanently on the program tape by typing RESTORE "BUGS" and pressing EXECUTE.

II. Modifying Plot Input.

A. Modifying array and string dimensions: All data and plotting arrays are declared in the INIT and SET_DEFAULTS subroutines. Data arrays are declared by the array name followed by parentheses containing the number of elements in the array. String arrays are similar with the addition of the number of characters contained in each element declared in brackets after the parentheses. NOTE: If the number of elements or characters allowed in an array is changed, the user may not store the graph on tape unless 1) the user makes this a permanent change in the program and restores any previously stored graphs in the new format; or 2) Make sure that the changes in the program have been made again before the graph is retrieved.

   1. Change the number of annotation labels allowed:
      Line # 160,180,210: Change the subscripts in Xa, Ya, Label$, and Plabel to the new number of annotation labels allowed.
      18700: Change the 40 to the new number of labels allowed.
   2. Change the number of characters allowed in string variables. Below is a list of all string variables that may be changed.

Title:	TS[30]
X axis label:	XS[20]
Y axis label:	YS[20]
Annotation labels:	Label$(40)[80]

B. Define a function of more than one variable: To change the function both the program and the special function key file "FUNKEY" must be changed.

   1. In the program, line # 5700 must be changed to call the function of all the variables that are to be passed. Variables may be added by inserting the new variables separated by commas within the parentheses.
   2. The special function key file must be changed by:
      a. Typing EDIT KEY 0 and then pressing EXECUTE.
      b. Press the DEL LINE key in the edit pad at the top left of the keyboard.
      c. Add new variables within the parentheses in the same order as they are listed in the program line # 5700.
      d. Press EXECUTE.

e. To change the program permanently:
   1) Press special function key kØ.
   2) Type PURGE "FUNKEY" and then press EXECUTE.

f. Type STORE KEY "FUNKEY" and then press EXECUTE.

III. Modifying plotting defaults: All defaults are set in the Set_defaults subroutine. There are two kinds of defaults used: (1) variables that flag the use of an option; and (2) size and dimension specifiers. Below is a list of the plot defaults that may be changed that contains the progran variable name and function with their default values.

	Function	Variable name	Default
A. Size specifiers:	Title size	Tsize	1
	Axes label size:	Lsize	1
	Number size:	Nsize	1
	Annotation size:	Asize	1
	Length of X axis:	Xsize	100
	Length of Y axis:	Ysize	60
B. Options Flags: (No=0, Yes=1)			
	Shading:	Shade	No
	Standard deviation	Sd	No
	Annotation	Annot	No
	Scientific Notation	Scinot	No
	Plot type	P1(*)	Lines
	Line type	Lt(*)	Solid
	Symbol	L$(*)	"*"
C. Graph parameters:	Frame	Frame	1
	Tic marks	Axes	1
	Numbers	Number	1
	Axes labels	Label	1
D. Miscellaneous:			
	Title	T$	Null
	X axis label	X$	Null
	Y axis label	Y$	Null
	Major tic intervals	Xm,Ym	4

IV. Modifying Plot Output.

A. Modifying histogram bar width: The width of the bar is given by half the distance between the smallest interval between any two X values minus two graphics units. For many plots, this gap appears much too small. To change this, replace the 4 in line 17650 with five times the new width. NOTE: The bars appear much thicker on the CRT than on the plotter.

APPENDIX C: PROGRAM LISTINGS

```
10  ! ######################   P R O G R A M   P L O T  ############
#####
20    GOSJB Init
30    GOSJB Options
40    GOSJB End_it
50 End: END ! ##################     E N D   P L O T   ###############
###
60    !
70    !
80 Init:  ! ################  SUBROUTINE TO INITIALIZE PROGRAM  ######
####
90    DEG
100   OPTION BASE 1
110   COM F$(25)[20],SHORT X1(25,200),Y1(25,200)
120   COM INTEGER Npt(25),Defaults,Log_ck,Pfile,P1(25),Lt(25),Pc2(25)
130   COM INTEGER Pt,Xm,Ym,Xsize,Ysize,Norm,Shade,Annot,Sd,File,Nt,Nx,
Ny
140   COM INTEGER Pc1,Pc3,Pc4,Scinot,Num_sd,Ann,Frame,Axes,Number,Labe
l
150   COM SHORT Xmx,Xmn,Ymx,Ymn,Xt,Yt,Tsize,Lsize,Nsize,Asize,Xmult,Ym
ult,S
160   COM SHORT X_max(25),X_min(25),Y_max(25),Y_min(25),Xa(40),Ya(40),
Cm(25),Xdp,Ydp
170   COM SHORT Xmax,Xmin,Ymax,Ymin,Sdx,Sdy,Nsd,Options
180   COM L$(25)[1],T$[30],X$[20],Y$[20],V$[10],P$(4)[12],Label$(40)[8
0]
190   COM Pen$(4)[5],Shade$[30],Norm$[30]
200   COM X_max$(25)[12],X_min$(25)[12],Y_max$(25)[12],Y_min$(25)[12]
210   COM INTEGER Norm(25),Shade(25),Plabel(40)
220   SHORT Xtemp(25,200),Ytemp(25,200)
230   INTEGER Ntemp(25)
240   DIM A$[80],B$[80],C$[80],D$[6],Ftemp$(25)[20],E$[20]
250   !
260   Pen$(1)="BLACK"
270   Pen$(2)="BLUE"
280   Pen$(3)="GREEN"
290   Pen$(4)="RED"
300   P$(1)="LINEAR"
310   P$(2)="X-LIN, Y-LOG"
320   P$(3)="X-LOG, Y-LIN"
330   P$(4)="X-LOG, Y-LOG"
340   Defaults=1
350 RETURN
360   !          ************************************
370   !          *                                  *
380   !          *          PROGRAM OPTIONS         *
390   !          *                                  *
400   !          ************************************
410 Options:  PRINT PAGE;LIN(2);TAB(30);"PROGRAM OPTIONS"
420   PRINT LIN(2);TAB(15);"(1) INPUT NEW DATA from keyboard, tape,
```

```
digitized on digital"
430   PRINT TAB(34);"plotter, and as a user defined function"
440   PRINT LIN(2);TAB(15);"(2) PLOT DATA on CRT, thermal printer or
 digital plotter"
450   PRINT LIN(2);TAB(15);"(3) SAVE DATA on tape"
460   PRINT LIN(2);TAB(15);"(4) RETRIEVE GRAPH from tape."
470   PRINT LIN(2);TAB(15);"(5) SAVE GRAPH on tape."
480   PRINT LIN(2);TAB(15);"(6) EXIT PROGRAM"
490   Options=0
500   INPUT "ENTER OPTION #",Options
510   IF (Options>=1) AND (Options<=6) THEN GOTO Goto_sub
520   BEEP
530   PRINT LIN(2);TAB(15);"OPTION NOT WITHIN 1 AND 6...TRY AGAIN"
540   GOTO 490
550 Goto_sub: IF Options=1 THEN GOSUB Input_data
560   IF Options=2 THEN CALL Plot_data
570   IF Options=3 THEN GOSUB Save_data
580   IF Options=4 THEN GOSUB Retrieve_graph
590   IF Options=5 THEN GOSUB Save_graph
600   IF Options=6 THEN RETURN
610   GOTO Options
620  RETURN
630   ! ##############################################################
640   ! #                                                            #
650   ! #                        INPUT DATA                          #
660   ! #                                                            #
670   ! ##############################################################
680 Input_data:  L1=1
690   Log_ck=0
700   Dig_flag=0
710   Norm=0
720   MAT Norm=(0)
730   Norm$=""
740   Crt=0
750   REDIM X1(25,200),Y1(25,200),Npt(25),F$(25)
760   REDIM Xtemp(25,200),Ytemp(25,200)
770 Start_in:  PRINT PAGE;LIN(1);TAB(30);"INPUT OPTIONS"
780   PRINT LIN(1);TAB(5);"This program allows you to input up to 5000
 data points."
790   PRINT TAB(5);"You may input a maximum of 25 data files to be plo
tted and/or"
800   PRINT TAB(5);"saved on tape. The maximum number of points allowe
d in each"
810   PRINT TAB(5);"data file therefore equals 5000 divided by the num
ber of files"
820   PRINT TAB(5);"to be input."
830   PRINT LIN(1);TAB(5);"To start program you must input at least on
e data file."
840   PRINT TAB(5);"Data files may be input from the keyboard, tape, d
igitized on"
```

```
850   PRINT TAB(5);"the digital plotter, defined as a function by the
user, or any"
860   PRINT TAB(5);"combination of these."
870   PRINT LIN(1);TAB(5);"You will now be asked interactively to ente
r the number of data files "
880   PRINT TAB(5);"that you want to be input from each input mode."
890 Go_back: PRINT LIN(1);TAB(5);"ENTER # of FILES to be INPUT from KE
YBOARD"
900   In(1)=0
910   INPUT In(1)
920   PRINT TAB(28);"INPUT from TAPE"
930   In(2)=0
940   INPUT In(2)
950   PRINT TAB(28);"DIGITIZED on DIGITAL PLOTTER"
960   In(3)=0
970   INPUT In(3)
980   PRINT TAB(28);"FUNCTION DEFINED by USER"
990   In(4)=0
1000  INPUT In(4)
1010  Pfile=In(1)+In(2)+In(3)+In(4)
1020  IF Pfile<=25 THEN GOTO 1060
1030  BEEP
1040  INPUT "    You may only input up to 25 files...Press CONT to T
RY AGAIN",A1
1050  GOTO Start_in
1060  IF Pfile<>0 THEN 1100
1070  BEEP
1080  INPUT "    You must input at least one data file...Press CONT
 to TRY AGAIN",A1
1090  GOTO Start_in
1100  Pts=INT(5000/Pfile)
1110  REDIM X1(Pfile,Pts),Y1(Pfile,Pts),Npt(Pfile),F$(Pfile)
1120  REDIM Xtemp(Pfile,Pts),Ytemp(Pfile,Pts),Ntemp(Pfile),Ftemp$(Pfil
e)
1130  IF In(1)>0 THEN GOSUB Keyboard
1140  IF In(2)>0 THEN GOSUB Tape
1150  IF In(3)>0 THEN GOSUB Digitize
1160  IF In(4)>0 THEN GOSUB Define_function
1170 RETURN
1180 Keyboard: ! ############## DATA INPUT FROM KEYBOARD ##############
####
1190  Key=1
1200  PRINT PAGE;LIN(2);TAB(25);"INPUT FROM KEYBOARD";LIN(2)
1210  PRINT LIN(2);TAB(10);"ENTER LABEL FOR DATA FILE #";L1;"...UP TO
20 CHRACTERS";LIN(3)
1220  INPUT F$(L1)
1230  PRINT LIN(1);TAB(10);"HOW MANY DATA PAIRS ARE TO BE INPUT INTO F
ILE #";L1;"?"
1240  PRINT LIN(1);TAB(25);"MAXIMUM ALLOWED IS";Pts
1250  Npt(L1)=0
```

```
1260  INPUT Npt(L1)
1270  IF Npt(L1)<>0 THEN GOTO 1310
1280  BEEP
1290  PRINT LIN(2);TAB(10);"YOU MUST INPUT AT LEAST ONE DATA PAIR"
1300  GOTO 1230
1310  IF Npt(L1)<=Pts THEN GOTO 1350
1320  BEEP
1330  PRINT LIN(2);TAB(10);"THE MAXIMUM NUMBER OF POINTS FOR ";Pfile;"
FILE(S) IS ";Pts;"...TRY AGAIN"
1340  GOTO 1230
1350  PRINT LIN(2);TAB(10);"IF DATA HAS CONSTANT INTERVAL BETWEEN X VA
LUES...ENTER 1"
1360  A1=0
1370  INPUT A1
1380  IF A1=1 THEN GOTO Constant_x
1390  PRINT PAGE
1400  PRINT LIN(2);TAB(10);"INPUT X VALUE...PRESS CONT...ENTER Y VAL
UE";LIN(2)
1410    FOR I=1 TO Npt(L1)
1420      BEEP
1430      PRINT TAB(20);"INPUT # ";I
1440      INPUT X1(L1,I)
1450      INPUT Y1(L1,I)
1460    NEXT I
1470  GOTO Fixit
1480 Constant_x: PRINT LIN(3);TAB(10);"INPUT FIRST VALUE FOR X  (i.e.
X1(1)=?)"
1490  INPUT X0
1500  PRINT LIN(2);TAB(10);"INPUT THE INCREMENT BETWEEN ADJACENT X VAL
UES"
1510  INPUT Dx
1520  PRINT PAGE;LIN(2);TAB(20);"INPUT Y VALUES"
1530    FOR I=1 TO Npt(L1)
1540      X1(L1,I)=X0+(I-1)*Dx
1550      BEEP
1560      PRINT LIN(2);TAB(20);" INPUT # ";I
1570      INPUT Y1(L1,I)
1580    NEXT I
1590  C$="KEYBOARD"
1600 Fixit: GOSUB Edit_data
1610  L1=L1+1
1620  Key=Key+1
1630  IF Key<=In(1) THEN GOTO 1200
1640 RETURN
1650 Tape: ! ################ DATA INPUT FROM TAPE ##################
1660  PRINT PAGE;LIN(4);TAB(25);"INPUT FROM TAPE";LIN(2)
1670  PRINT "THE DATA TAPE IS ASSUMED TO BE IN THE LEFT (:T14) CASSETT
E DRIVE"
1680  PRINT "IF NOT THEN LOAD THE CASSETTE...PRESS CONT TO PROCEED";
LIN(2)
```

```
1690  INPUT A1
1700  Tape=1
1710 Cat: CAT ":T14"
1720  PRINT LIN(2);"THIS IS A CATOLOG OF THE DATA FILES ON THE TAPE...
USE THE"
1730  PRINT "ARROWS IN THE DISPLAY PAD ON THE KEYBOARD TO SCROLL UP AN
D DOWN"
1740  PRINT LIN(2);"INPUT THE DATA SET TO BE USED FOR FILE #";L1;LIN(2
)
1750  INPUT D$
1760  C$=D$&":T14"
1770  ON ERROR GOTO Name_err
1780  ASSIGN #1 TO C$
1790  OFF ERROR
1800   READ #1;A$,Nfile
1810   REDIM Ntemp(Nfile),Ftemp$(Nfile)
1820  REDIM Xtemp(Nfile,5000/Nfile),Ytemp(Nfile,5000/Nfile)
1830   READ #1;Ntemp(*),Ftemp$(*)
1840    FOR K=1 TO Nfile
1850      FOR J=1 TO Ntemp(K)
1860        READ #1;Xtemp(K,J)
1870      NEXT J
1880      FOR J=1 TO Ntemp(K)
1890        READ #1;Ytemp(K,J)
1900      NEXT J
1910    NEXT K
1920  ASSIGN #1 TO *
1930 Pickfile: PRINT PAGE
1940  PRINT LIN(2);TAB(23);"DATA SET DISCRIPTOR IS";LIN(2);TAB(23);A$;
LIN(3)
1950  PRINT TAB(15);"THE SET HAS";Nfile;"FILES ... DESCRIPTORS ARE";LI
N(2)
1960    FOR I=1 TO Nfile
1970      PRINT USING 1980;"FILE #";I,Ftemp$(I)
1980      IMAGE 25X,6A,DD,5X,20A
1990    NEXT I
2000  PRINT LIN(3);TAB(10);"INPUT the data file number you want to u
se for FILE #";L1
2010  Ifile=0
2020  INPUT Ifile
2030  IF Ifile=0 THEN GOTO Cat
2040  K=Ifile
2050  IF (Ifile>0) AND (Ifile<Nfile+1) THEN GOTO 2090
2060  BEEP
2070  PRINT LIN(2);TAB(15);"FILE # IS NOT WITHIN THE SET...TRY AGAIN"
2080  GOTO 2020
2090  IF Ntemp(Ifile)<=Pts THEN GOTO Fill
2100  BEEP
2110  PRINT PAGE;LIN(4);TAB(30);"DIMENSION ERROR"
2120  PRINT LIN(4);TAB(20);"THIS FILE HAS ";Ntemp(Ifile)*20;" POINTS I
```

```
N IT."
2130  PRINT LIN(2);TAB(10);"THE MAXIMUM NUMBER OF POINTS ALLOWED FOR "
;Pfile;" FILE(S) IS ";Pts
2140  GOTO 2370
2150 Fill: F$(L1)=Ftemp$(Ifile)
2160    FOR K=1 TO Ntemp(Ifile)
2170      X1(L1,K)=Xtemp(Ifile,K)
2180      Y1(L1,K)=Ytemp(Ifile,K)
2190    NEXT K
2200  Npt(L1)=Ntemp(Ifile)
2210  GOSUB Edit_data
2220  PRINT PAGE;LIN(6);TAB(30);"INPUT CHECK"
2230  PRINT LIN(4);TAB(10);"IF THIS IS NOT THE CORRECT DATA FILE AND
 YOU WOULD LIKE"
2240  PRINT LIN(2);TAB(10);"TO TRY ANOTHER ONE ... ENTER 1"
2250  Again=0
2260  INPUT Again
2270  IF Again=1 THEN GOTO 2370
2280  L1=L1+1
2290  Tape=Tape+1
2300  IF Tape>In(2) THEN RETURN
2310  PRINT PAGE;LIN(4);TAB(30);"GET NEXT FILE"
2320  PRINT LIN(4);TAB(10);"ENTER 0...TO PLOT ANOTHER FILE FROM THIS D
ATA SET"
2330  PRINT LIN(2);TAB(10);"ENTER 1...TO PLOT A FILE FROM A DIFFERENT
DATA SET"
2340  A1=0
2350  INPUT A1
2360  ON A1+1 GOTO Pickfile,Cat
2370  PRINT LIN(4);TAB(10);"ENTER 0...TO TRY A DIFFERENT DATA FILE"
2380  PRINT LIN(2);TAB(10);"ENTER 1...TO TRY A DIFFERENT DATA SET"
2390  A1=0
2400  INPUT A1
2410  ON A1+1 GOTO Pickfile,Cat
2420 Name_err: E=ERRN
2430  IF E<>53 THEN GOTO 2480
2440  BEEP
2450  PRINT LIN(2);"ERROR 53: IMPROPER FILE NAME ...PRESS CONT TO TR
Y AGAIN"
2460  INPUT A1
2470  GOTO Cat
2480  IF E<>56 THEN GOTO 2530
2490  BEEP
2500  PRINT "ERROR 56: FILE NAME DOES NOT EXIST...PRESS CONT TO TRY
AGAIN"
2510  INPUT A1
2520  GOTO Cat
2530  GOTO Error_end
2540 RETURN
2550 Digitize: ! ###############  DIGITIZED INPUT  ##################
```

```
2560  C$="DIGITIZED"
2570  Dig_flag=1
2580  Digitt=1
2590  GOSUB Dig_init
2600  Graph=1
2610  GOSUB Digit
2620  Scaleck=0
2630  GOSUB Dig_opts
2640  L1=_1+1
2650  Graph=Graph+1
2660  Digitt=Digitt+1
2670  IF Digitt>In(3) THEN RETURN
2680  IF Graph<=Gr THEN 2610
2690  GOTO 2590
2700 RETURN
2710 Dig_init: ! ### SUBROUTINE TO DIGITIZE CORNERS OF GRAPH
2720   PRINT PAGE;LIN(3);TAB(30);"DIGITIZE"
2730   PRINT LIN(3);TAB(15);"TO SET UP PLOTTER FOR DIGITIZING:"
2740   PRINT LIN(2);TAB(19);"(1) TURN PLOTTER ON"
2750   PRINT TAB(19);"(2) LOAD GRAPH ANYWHERE ON PLATTEN"
2760   PRINT TAB(19);"(3) PUT DIGITIZING PEN INTO THE LEFTMOST PEN HOL
DER"
2770   PRINT LIN(3);TAB(15);"INPUT THE NUMBER OF DIFFERENT FILES THAT"
2780   PRINT TAB(17);"YOU WANT TO DIGITIZE ON THIS GRAPH ?"
2790   Gr=0
2800   INPUT "?",Gr
2810   IF Gr<>0 THEN 2850
2820   BEEP
2830   PRINT LIN(1);TAB(8);"YOU MUST INPUT AT LEAST ONE FILE ON THIS
 GRAPH...TRY AGAIN"
2840   GOTO 2800
2850   IF Gr+Digitt-1<=In(3) THEN GOTO 2890
2860   BEEP
2870   PRINT LIN(1);TAB(8);"THE NUMBER OF GRAPHS LEFT TO BE DIGITIZED
IS";In(3)-Digitt+1;"...TRY AGAIN"
2880   GOTO 2800
2890   PRINT PAGE;TAB(30);"INITIALIZE GRAPH"
2900   PRINT LIN(1);TAB(5);"TO DIGITIZE: Press PEN DOWN button on PL
OTTER"
2910   PRINT TAB(18);"Position DIGITIZING PEN over point to be digitiz
ed"
2920   PRINT TAB(18);"Press ENTER button on PLOTTER to input the point
"
2930   PRINT LIN(1);TAB(15);"(1) DIGITIZE lower left corner of graph f
rame"
2940   PRINT LIN(1);TAB(15);"(2) DIGITIZE upper left corner of graph f
rame"
2950   PRINT LIN(1);TAB(15);"(3) DIGITIZE upper right corner of graph
frame"
2960   PRINT LIN(1);TAB(15);"(4) DIGITIZE lower right corner of graph
```

```
frame";LIN(1)
2970   PLOTTER IS 7,5,"9872A"
2980   PEN 1
2990   FOR I=1 TO 4
3000     DIGITIZE Xframe(I),Yframe(I)
3010     BEEP
3020     PRINT TAB(28);"CORNER #";I;" DIGITIZED".
3030   NEXT I
3040   PRINT LIN(1);TAB(12);"PRESS  CONT  when you have DIGITIZED al
l four co^ners"
3050   INPUT A1
3060   PRINT PAGE;LIN(6);TAB(31);"SCALE TYPE"
3070   PRINT LIN(2);TAB(21);"ENTER 1...IF PLOT IS LINEAR"
3080   PRINT TAB(21);"ENTER 2...IF PLOT IS X-LIN, Y-LOG"
3090   PRINT TAB(21);"ENTER 3...IF PLOT IS X-LOG, Y-LIN"
3100   PRINT TAB(21);"ENTER 4...IF PLOT IS X-LOG, Y-LOG"
3110   PRINT LIN(2);TAB(10);"NOTE: IF YOU ARE CHOOSING A LOG AXIS, T
HE SCALE _IMITS "
3120   PRINT TAB(16);"FOR THAT AXIS MUST BE POWERS OF TEN (i.e. .01,10
0)";LIN(2)
3130   Pt=0
3140   INPUT Pt
3150   IF (Pt>0) AND (Pt<5) THEN GOTO 3190
3160   BEEP
3170   PRINT LIN(1);TAB(18);"INPUT is not within range...TRY AGAIN"
3180   GOTO 3140
3190   PRINT PAGE;LIN(3);TAB(27);"GRAPH RANGE"
3200   PRINT LIN(3);TAB(10);"You will now be asked to input the limits
 of the scales"
3210   PRINT TAB(10);"on each axis of the graph that you are digitizin
g"
3220   PRINT LIN(2);TAB(15);"INPUT THE X AXIS GRAPH LIMITS (MIN,MAX)"
3230   INPUT Xmn,Xmx
3240   IF Xmx-Xmn<>0 THEN GOTO 3280
3250   BEEP
3260   PRINT LIN(2);TAB(10);"The graph range must be greater than 0.
..TRY AGAIN"
3270   GOTO 3230
3280   IF Pt<3 THEN GOTO 3350
3290   Check_lgt=INT(LGT(Xmx))-LGT(Xmx)+INT(LGT(Xmn))-LGT(Xmn)
3300   IF Check_lgt=0 THEN GOTO 3350
3310   BEEP
3320   PRINT LIN(2);TAB(10);"The graph limits for a log axis must be
 powers of 10"
3330   PRINT TAB(10);"(i.e. .001,1000)...TRY AGAIN"
3340   GOTO 3230
3350   PRINT LIN(2);TAB(15);"INPUT THE Y AXIS GRAPH LIMITS (MIN,MAX)"
3360   INPUT Ymn,Ymx
3370   IF Ymx-Ymn<>0 THEN GOTO 3410
3380   BEEP
```

```
3390   PRINT LIN(2);TAB(10);"The graph range must be greater than 0.
..TRY AGAIN"
3400   GOTO 3360
3410   IF (Pt=1) OR (Pt=3) THEN GOTO 3470
3420   Check_lgt=INT(LGT(Ymx))-LGT(Ymx)+INT(LGT(Ymn))-LGT(Ymn)
3430   IF Check_lgt=0 THEN GOTO 3470
3440   PRINT LIN(2);TAB(10);"The graph limits for a log axis must be
 powers of 10"
3450   PRINT TAB(10);"(i.e. .001,1000)...TRY AGAIN"
3460   GOTO 3360
3470 RETURN
3480 Digit:  ! ############  SUBROUTINE TO DIGITIZE FILES  ############
#######
3490   PRINT PAGE;TAB(30);"DIGITIZE FILES:"
3500   PRINT LIN(2);TAB(15);"You are allowed to DIGITIZE up to";Pts;"p
oints per file"
3510   PRINT TAB(15);"Digitizing accuracy is generally 3%, therefore,
three"
3520   PRINT TAB(15);"significant digits will be digitized"
3530   PRINT LIN(2);TAB(8);"(1)  ENTER DESCRIPTOR for this data file
...Up to 20 characters"
3540   PRINT LIN(2);TAB(8);"(2)  TO DIGITIZE: Press PEN DOWN butto
n on PLOTTER"
3550   PRINT TAB(26);"Position DIGITIZING PEN over point to be digitiz
ed "
3560   PRINT TAB(26);"Press ENTER button on PLOTTER to input the poi
nt"
3570   PRINT LIN(1);TAB(8);"(3)  DELETE A POINT: Digitize that same
point twice in a row"
3580   PRINT LIN(2);TAB(8);"(4)  TO EXIT: DIGITIZING mode PRESS P1
 "
3590   PRINT TAB(38);"PRESS ENTER"
3600   LINPUT "ENTER DATA DESCRIPTOR -",F$(L1)
3610   K=1
3620   PLOTTER IS 7,5,"9872A"
3630 Dig:DIGITIZE Xtemp(L1,K),Ytemp(L1,K)
3640   BEEP
3650   IF (Xtemp(L1,K)=0) AND (Ytemp(L1,K)=0) THEN Exit
3660   IF K=1 THEN GOTO 3680
3670   IF (Xtemp(L1,K)=Xtemp(L1,K-1)) AND (Ytemp(L1,K)=Ytemp(L1,K-1))
THEN K=K-2
3680   K=K+1
3690  GOTO Dig
3700 Exit: IF K<>1 THEN K=K-1
3710   BEEP
3720   WAIT 500
3730   BEEP
3740 RETURN
3750 Dig_opts:! ### SUBROUTINE FOR DIG. OUTPUT OPTIONS & EDITING
3760  Ed=3
```

```
3770   PRINT PAGE;LIN(1);TAB(25);"DIGITIZING EDIT OPTIONS"
3780   PRINT LIN(2);TAB(12);"OPTION #"
3790   PRINT TAB(14);"(1)   PLOT DATA on CRT";LIN(1)
3800   PRINT TAB(14);"(2)   PRINT DATA on THERMAL PRINTER";LIN(1)
3810   PRINT TAB(14);"(3)   EDIT DATA using NUMERICAL values for edi
t";LIN(1)
3820   PRINT TAB(14);"(4)   EDIT DATA using your original graph on
 DIGITAL PLOTTER";LIN(1)
3830   IF Digitt=In(3) THEN GOTO 3860
3840   PRINT LIN(2);TAB(22);"PRESS CONT DIGITIZE next file";LIN(2)
3850   GOTO 3880
3860   PRINT LIN(2);TAB(22);"PRESS CONT TO EXIT DIGITIZE routine and
"
3870   PRINT LIN(1);TAB(25);"return to PROGRAM OPTIONS";LIN(1)
3880   Scaleck=Scaleck+1
3890   D0=0
3900   INPUT D0
3910   IF (D0>=0) AND (D0<=4) THEN GOTO 3950
3920   BEEP
3930   PRINT LIN(1);TAB(12);"DIGITIZE OPTION is not between 1 and 4.
..TRY AGAIN"
3940   GOTO 3900
3950   IF Scaleck=1 THEN GOSUB Dig_scale
3960   IF D0=0 THEN RETURN
3970   ON D0 GOSUB Dig_plot,Hard,Edit_data,Dig_edit
3980   GOTO Dig_opts
3990 RETURN
4000 Dig_scale: ! ### SUBROUTINE TO CONVERT DATA TO USER UNITS
4010   Npt(L1)=K
4020   Theta=0
4030   IF Xframe(1)=Xframe(4) THEN 4060
4040   Theta=ATN((Yframe(4)-Yframe(1))/(Xframe(4)-Xframe(1)))
4050   GOSUB Rotate
4060   GOSUB Rescale
4070   GOSUB Round
4080 RETURN
4090 Rotate:!
4100   FOR I=1 TO 4
4110     Xframe(I)=Xframe(I)*COS(Theta)+Yframe(I)*SIN(Theta)
4120     Yframe(I)=-Xframe(I)*SIN(Theta)+Yframe(I)*COS(Theta)
4130   NEXT I
4140   FOR I=1 TO K
4150     Xtemp(L1,I)=Xtemp(L1,I)*COS(Theta)+Ytemp(L1,I)*SIN(Theta)
4160     Ytemp(L1,I)=-Xtemp(L1,I)*SIN(Theta)+Ytemp(L1,I)*COS(Theta)
4170   NEXT I
4180 RETURN
4190 Rescale:!
4200   Yscale=Yframe(3)-Yframe(1)
4210   Xscale=Xframe(3)-Xframe(1)
4220   ON Pt GOTO 4230,4290,4260,4320
```

```
4230     Xsc=(Xmx-Xmn)/Xscale
4240     Ysc=(Ymx-Ymn)/Yscale
4250     GOTO 4340
4260     Xsc=(LGT(Xmx)-LGT(Xmn))/Xscale
4270     Ysc=(Ymx-Ymn)/Yscale
4280     GOTO 4340
4290     Xsc=(Xmx-Xmn)/Xscale
4300     Ysc=(LGT(Ymx)-LGT(Ymn))/Yscale
4310     GOTO 4340
4320     Xsc=(LGT(Xmx)-LGT(Xmn))/Xscale
4330     Ysc=(LGT(Ymx)-LGT(Ymn))/Yscale
4340     FOR I=1 TO K
4350       IF (Pt=1) OR (Pt=2) THEN X1(L1,I)=Xmn+(Xtemp(L1,I)-Xframe(1)
)*Xsc
4360       IF (Pt=3) OR (Pt=4) THEN X1(L1,I)=Xmn*10^((Xtemp(L1,I)-Xfram
e(1))*Xsc)
4370       IF (Pt=1) OR (Pt=3) THEN Y1(L1,I)=Ymn+(Ytemp(L1,I)-Yframe(1)
)*Ysc
4380       IF (Pt=2) OR (Pt=4) THEN Y1(L1,I)=Ymn*10^((Ytemp(L1,I)-Yfram
e(1))*Ysc)
4390     NEXT I
4400 RETURN
4410 Round: !
4420     FOR I=1 TO K
4430       Tenx=0
4440       Teny=0
4450       IF X1(L1,I)<>0 THEN Tenx=INT(LGT(ABS(X1(L1,I))))-2
4460       IF Y1(L1,I)<>0 THEN Teny=INT(LGT(ABS(Y1(L1,I))))-2
4470       X1(L1,I)=PROUND(X1(L1,I),Tenx)
4480       Y1(L1,I)=PROUND(Y1(L1,I),Teny)
4490     NEXT I
4500 Rotate_back: ! #####  SUBROUTINE TO SCALE DATA BACK TO GRAPH UNIT
S  ###
4510   IF Theta=0 THEN GOTO 4540
4520   Theta=-Theta
4530   GOSUB Rotate
4540 RETURN
4550 Dig_plot:     ! ### SUBROUTINE TO PLOT DIGITIZED DATA ON CRT OR PL
OTTER
4560    IF Yscale/100>Xscale/123 THEN S=100/Yscale
4570    IF Xscale/123>=Yscale/100 THEN S=123/Xscale
4580    PLOTTER IS 13,"GRAPHICS"
4590    GRAPHICS
4600    LOCATE 0,Xscale*S,0,Yscale*S
4610    SCALE Xframe(1),Xframe(3),Yframe(1),Yframe(3)
4620    LINE TYPE 1
4630    FRAME
4640    LORG 5
4650    CSIZE 2
4660    IF K>100 THEN CSIZE 1
```

```
4670    MOVE Xtemp(L1,1),Ytemp(L1,1)
4680     FOR I=1 TO K
4690       DRAW Xtemp(L1,I),Ytemp(L1,I)
4700       L$="O"
4710       LABEL L$
4720       MOVE Xtemp(L1,I),Ytemp(L1,I)
4730     NEXT I
4740    PAUSE
4750    EXIT GRAPHICS
4760 RETURN
4770 Dig_edit: ! ### SUBROUTINE TO EDIT DIGITIZED DATA USING DIGITAL P
LOTTER
4780    PRINT PAGE;LIN(2);TAB(25);"RE-DIGITIZING OPTIONS"
4790    PRINT LIN(2);TAB(10);"DO NOT remove GRAPH from its position on
DIGITAL PLOTTER."
4800    PRINT TAB(10);"The DIGITIZING PEN will be stepped across GRAPH
showing the"
4810    PRINT TAB(10);"points which you have DIGITIZED."
4820    PRINT LIN(1);TAB(8);"OPTION #"
4830    PRINT TAB(10);"(1)    RE-DIGITIZE A POINT ";LIN(1)
4840    PRINT TAB(10);"(2)    ADD A POINT ";LIN(1)
4850    PRINT TAB(10);"(3)    DELETE A POINT";LIN(1)
4860    PRINT TAB(10);"(4)    EXIT RE-DIGITIZING and RETURN to DIGITIZ
ING OPTIONS"
4870    Scaleck=0
4880    GOSUB Rotate_back
4890    PLOTTER IS 7,5,"9872A"
4900    FOR I=1 TO K
4910      MOVE Xtemp(L1,I),Ytemp(L1,I)
4920      A1=0
4930      INPUT "          ENTER OPTION #...To go on to NEXT point PRESS
 CONT",A1
4940      IF (A1>=0) AND (A1<=4) THEN GOTO 4990
4950      BEEP
4960      PRINT LIN(2);TAB(8);"OPTION # is not between 1 and 4...Pres
s CONT and TRY AGAIN"
4970      PAUSE
4980      GOTO 4780
4990      IF A1=0 THEN GOTO 5250
5000      IF A1=4 THEN RETURN
5010      IF A1=3 THEN GOTO 5090
5020      IF A1=2 THEN GOTO 5160
5030      DISP TAB(10);"RE-DIGITIZE this POINT NOW."
5040      POINTER Xtemp(L1,I),Ytemp(L1,I)
5050      DIGITIZE Xtemp(L1,I),Ytemp(L1,I)
5060      BEEP
5070      INPUT "           DATA POINT RE-DIGITIZED...PRESS CONT to EN
TER next OPTION #",A1
5080      GOTO 5250
5090      FOR J=I TO K-1
```

```
5100        Xtemp(L1,J)=Xtemp(L1,J+1)
5110        Ytemp(L1,J)=Ytemp(L1,J+1)
5120      NEXT J
5130      INPUT "          DATA POINT DELETED...PRESS CONT to ENTER ne
xt OPTION #",A1
5140      K=K-1
5150      GOTO 5250
5160      POINTER Xtemp(L1,I),Ytemp(L1,I)
5170        FOR J=K TO I+1 STEP -1
5180          Xtemp(L1,J+1)=Xtemp(L1,J)
5190          Ytemp(L1,J+1)=Ytemp(L1,J)
5200        NEXT J
5210      DISP "          DIGITIZE NEW POINT NOW"
5220      DIGITIZE Xtemp(L1,I+1),Ytemp(L1,I+1)
5230      BEEP
5240      INPUT "          NEW POINT DIGITIZED...PRESS CONT to ENTER n
ext OPTION #",A1
5250    NEXT I
5260  GOSUB Rotate_back
5270 RETURN
5280 Define_function: ! ########## SUBROUTINE TO LET USER   ######
5290  !                    ######  DEFINE A FUNCTION TO PLOT ####
5300  C$="FUNCTION"
5310    FOR Function=1 TO In(4)
5320      PRINT PAGE;LIN(1);TAB(27);"INPUT A FUNCTION"
5330      PRINT LIN(3);TAB(15);"INPUT file DESCRIPTOR for this FUNCTIO
N"
5340      INPUT F$(L1)
5350      PRINT LIN(2);TAB(15);"INPUT NUMBER OF POINTS that you want t
o plot fo~"
5360      PRINT LIN(1);TAB(15);"this FUNCTION...MAXIMUM number ALLOWED
 is ";Pts
5370      Npt(L1)=0
5380      INPUT Npt(L1)
5390      IF Npt(L1)>0 THEN GOTO 5430
5400      BEEP
5410      PRINT LIN(1);TAB(15);"You must INPUT the NUMBER of POINTS
to be plotted...TRY AGAIN"
5420      GOTO 5380
5430      IF Npt(L1)<=Pts THEN GOTO 5480
5440      BEEP
5450      PRINT LIN(1);TAB(15);"The NUMBER of points you have INPUT is
 greater"
5460      PRINT TAB(15);"than";Pts;"...TRY AGAIN"
5470      GOTO 5380
5480      PRINT LIN(2);TAB(33);"NOTE"
5490      PRINT LIN(1);TAB(8);"ALL TRIGONOMETRIC FUNCTIONS WILL BE COM
PUTED IN DEGREES"
5500      PRINT LIN(2);TAB(15);"INPUT the DATA RANGE for X (X MIN,X MA
X)"
```

```
5510       Xmnn=Xmxx=0
5520       INPUT Xmnn,Xmxx
5530       IF Xmxx-Xmnn>0 THEN GOTO 5570
5540       BEEP
5550       PRINT LIN(1);TAB(15);"X DATA RANGE must be GREATER than 0.
..TRY AGAIN"
5560       GOTO 5510
5570       PRINT PAGE;LIN(2);TAB(30);"TO DEFINE FUNCTION:"
5580       PRINT LIN(3);TAB(9);"(1) PRESS k0 Special Function Key..
.(upper right corner of keyboard)"
5590       PRINT LIN(2);TAB(9);"(2) TYPE in function using HP format
as described in the"
5600       PRINT TAB(21);"Operating and Programming Manual, Chapter 4
"
5610       PRINT LIN(2);TAB(9);"(3) PRESS STORE KEY...located direc
tly above the right SHIFT KEY"
5620       INPUT "      PRESS CONT TO CONTINUE",A1
5630       Inc=Xmxx-Xmnn
5640       IF Npt(L1)<>1 THEN Inc=Inc/(Npt(L1)-1)
5650       IF Inc<>0 THEN Inc=PROUND(Inc,INT(LGT(ABS(Inc)))-3)
5660       Start=Xmnn-Inc
5670         FOR I=1 TO Npt(L1)
5680           X1(L1,I)=Start+I*Inc
5690           X=X1(L1,I)
5700           Y1(L1,I)=FNX(X)
5710           IF Y1(L1,I)<>0 THEN Y1(L1,I)=PROUND(Y1(L1,I),INT(LGT(ABS
(Y1(L1,I))))-3)
5720         NEXT I
5730       GOSUB Edit_data
5740       L1=L1+1
5750     NEXT Function
5760 RETURN
5770 DEF FNX(X)=3*SIN(X)
5780  ! ##################  SUBROUTINE TO EDIT DATA  ################
##
5790 Edit_data: PRINT PAGE;LIN(2)
5800  L1$=VAL$(L1)
5810  PRINT TAB(6);" *** OPPORTUNITY TO REVIEW AND EDIT DATA FOR FILE
#";L1$;" ***"
5820  PRINT LIN(4);TAB(20);"(1) REVEIW DATA";LIN(3);TAB(20);"(2) ED
IT DATA"
5830  PRINT LIN(2);TAB(20);"(3) PRINT DATA ON THERMAL PRINTER"
5840  PRINT LIN(3);TAB(10);"ENTER the OPTION # that you would like to
use."
5850  PRINT LIN(2);TAB(10);"PRESS CONT TO CONTINUE ON TO NEXT FILE"
5860  Ed=0
5870  INPUT Ed
5880  IF (Ed>=0) AND (Ed<=3) THEN GOTO 5920
5890  BEEP
5900  INPUT "         OPTION # IS NOT WITHIN 0 AND 3...TRY AGAIN",Ed
```

```
5910  GOTO 5880
5920  IF Ed=0 THEN RETURN
5930  ON Ed GOSUB Reveiw,Edit_it,Hard
5940  GOTO Edit_data
5950 RETURN
5960 Edit_it: PRINT PAGE;LIN(2);TAB(30);"EDIT DATA"
5970  PRINT LIN(2);TAB(10);"INPUT THE # FOR THE DATA PAIR YOU WANT TO
MODIFY"
5980  INPUT A1
5990  IF (A1>0) AND (A1<Npt(L1)+1) THEN GOTO Ok
6000  BEEP
6010  INPUT "         # FOR DATA PAIR IS OUT OF RANGE..TRY AGAIN",A1
6020  GOTO 5990
6030 Ok: PRINT LIN(2);TAB(10);"X =";X1(L1,A1);"  Y =";Y1(L1,A1)
6040  PRINT LIN(2);TAB(10);"INPUT NEW VALUES FOR X,Y"
6050  INPUT X1(L1,A1),Y1(L1,A1)
6060  IF NOT Dig_flag THEN GOTO 6110
6070  IF (Pt=1) OR (Pt=2) THEN Xtemp(L1,A1)=(X1(L1,A1)-Xmn)/Xsc+Xframe
(1)
6080  IF (Pt=3) OR (Pt=4) THEN Xtemp(L1,A1)=LGT(X1(L1,A1)/Xmn)/Xsc+Xfr
ame(1)
6090  IF (Pt=1) OR (Pt=3) THEN Ytemp(L1,A1)=(Y1(L1,A1)-Ymn)/Ysc+Yframe
(1)
6100  IF (Pt=2) OR (Pt=4) THEN Ytemp(L1,A1)=LGT(Y1(L1,A1)/Ymn)/Ysc+Yfr
ame(1)
6110  A1=0
6120  PRINT LIN(2);TAB(10);"TO CONTINUE EDITING ENTER 1"
6130  INPUT A1
6140  IF A1=1 THEN GOTO Edit_it
6150 RETURN
6160 Reveiw: PRINT PAGE
6170 Hard: IF Ed=3 THEN PRINTER IS 0
6180  PRINT TAB(20);"DATA SET:  ";C$;LIN(1)
6190  PRINT TAB(20);"DATA FILE #";L1;" ";F$(L1)
6200  PRINT LIN(2)
6210  PRINT USING 6220;"PAIR #";"X VALUE";"Y VALUE"
6220  IMAGE 9X,20A,20A,20A
6230  C0=0
6240    FOR I=1 TO Npt(L1)
6250      X1$=VAL$(X1(L1,I))
6260      Y1$=VAL$(Y1(L1,I))
6270      I$="  "&VAL$(I)
6280      PRINT USING 6220;I$;X1$;Y1$
6290      C0=C0+1
6300      IF (C0<18) OR (Ed=3) THEN GOTO 6340
6310      C0=0
6320      PRINT "PRESS CONT TO CONTINUE"
6330      INPUT A1
6340    NEXT I
6350  IF Ed=3 THEN PRINTER IS 16
```

```
6360  IF Ed=1 THEN PAUSE
6370 RETURN
6380 End_edit: RETURN
6390  ! ##################################################################
#######
6400  ! #
      #
6410  ! #                    SAVE DATA ON DATA TAPE
      #
6420  ! #
      #
6430  ! ##################################################################
#######
6440 Save_data: !
6450  PRINT PAGE;LIN(3);TAB(30);"SAVE DATA ON TAPE"
6460  PRINT LIN(4);TAB(10);"IF DATA WAS INPUT FROM ONE DATA SET AND IS
 TO BE STORED"
6470  PRINT LIN(1);TAB(10);"IN THE SAME DATA SET...ENTER 1"
6480  PRINT LIN(4);TAB(4);"NOTE: IF YOU TRY TO RESTORE THE DATA FILE
S THAT YOU HAVE INPUT INTO "
6490  PRINT TAB(10);"THE SAME DATA SET THAT THEY CAME OUT OF, ANY FILE
S THAT WERE NOT "
6500  PRINT TAB(10);"INPUT FROM THAT SET WILL BE DESTROYED"
6510  Restore=0
6520  INPUT Restore
6530  PRINT PAGE
6540  CAT ":T14"
6550  PRINT LIN(2);"INPUT NAME FOR THIS DATA SET...UP TO 6 CHARACTERS"
6560  INPUT D$
6570  C$=D$&":T14"
6580  IF Restore=1 THEN PURGE C$
6590  Mxnpt=-99999
6600  Npt=0
6610    FOR L1=1 TO Pfile
6620      IF Npt(L1)>Mxnpt THEN Mxnpt=Npt(L1)
6630      Npt=Npt+Npt(L1)#2
6640    NEXT L1
6650  Nr=52+32*Pfile+4*Npt
6660  Nr=INT(Nr/80)+1
6670  CREATE C$,Nr,80
6680  IF Restore=1 THEN Skip_label
6690  PRINT PAGE;LIN(2);TAB(25);"INPUT DATA SET DESCRIPTOR"
6700  PRINT LIN(2);TAB(20);"THERE ARE";Pfile;"DATA FILES IN THIS SET"
6710  PRINT LIN(1);TAB(17);"FILE DESCRIPTORS FOR THE DATA FILES ARE:"
6720  PRINT LIN(1);TAB(25);"FILE #    DESCRIPTOR";LIN(2)
6730    FOR K=1 TO Pfile
6740      PRINT TAB(26);K;TAB(35);F$(K)
6750    NEXT K
6760  PRINT LIN(4);TAB(10);"INPUT DATA DESCRIPTOR FOR DATA SET...UP TO
 40 CHARACTERS"
```

```
6770  INPUT A$
6780 Skip_d: GOSUB Print_data
6790 RETURN
6800 Print_data: C$=D$&":T14"
6810  ASSIGN #2 TO C$
6820  PRINT #2;A$,Pfile,Npt(*),F$(*)
6830    FOR L1=1 TO Pfile
6840        FOR J=1 TO Npt(L1)
6850          PRINT #2;X1(L1,J)
6860        NEXT J
6870        FOR J=1 TO Npt(L1)
6880          PRINT #2;Y1(L1,J)
6890        NEXT J
6900    NEXT L1
6910 RETURN
6920 Save_graph: !
6930  PRINT PAGE;LIN(3);TAB(25);"SAVE GRAPH ON TAPE"
6940  PRINT LIN(4);TAB(10);"IF THIS GRAPH WAS RETRIEVED FROM THE TAPE
AND IS"
6950  PRINT TAB(10);"TO BE RE-STORED INTO THAT SAME DATA FILE...ENTER
1"
6960  Restore=0
6970  INPUT Restore
6980  PRINT PAGE
6990  CAT ":T14"
7000  PRINT LIN(2);"INPUT NAME FOR THIS DATA SET...UP TO 6 CHARACTERS"
7010  INPUT D$
7020  C$=D$&":T14"
7030  IF Restore=1 THEN PURGE C$
7040  Mxnpt=-99999
7050  Npt=0
7060    FOR L1=1 TO Pfile
7070      IF Npt(L1)>=Mxnpt THEN Mxnpt=Npt(L1)
7080      Npt=Npt+Npt(L1)*2
7090    NEXT L1
7100  Nr=348+Ann*100+25*45+52+32*Pfile+4*Npt
7110  Nr=INT(Nr/80)+1
7120  CREATE C$,Nr,80
7130  IF Restore=1 THEN GOTO Skip_g
7140  PRINT PAGE;LIN(4);TAB(28);"INPUT GRAPH DESCRIPTION"
7150  PRINT LIN(3);TAB(18);"INPUT THE NAME OF THE DATA FILE DESCRIPTOR
"
7160  PRINT LIN(1);TAB(21);"FOR THIS GRAPH...UP TO 40 CHARACTERS"
7170  INPUT A$
7180 Skip_g: GOSUB Print_data
7190  Option=4
7200  PRINT #2;Defaults,Log_ck,P1(*),Lt(*),Pc2(*),Pt,Xm,Ym,Xsize,Ysize
,Norm
7210  PRINT #2;Shade,Annot,Sd,File,Nt,Nx,Ny,Pc1,Pc3,Pc4,Scinot,Num_sd,
Xmx,Xmn
```

```
7220  PRINT #2;Ymx,Ymn,Xt,Yt,Tsize,Lsize,Nsize,Asize,Xmult,Ymult,S,Opt
ion
7230  PRINT #2;X_max(*),X_min(*),Y_max(*),Y_min(*),Cm(*),Xdp,Ydp,Xmax,
Xmin
7240  PRINT #2;Ymax,Ymin,Sdx,Sdy,Nsd,L$(*),T$,X$,Y$,Norm(*),Shade(*),A
nn
7250  PRINT #2;Shade$,Norm$,Frame,Axes,Number,Label
7260    FOR I=1 TO Ann+1
7270      PRINT #2;Xa(I),Ya(I),Plabel(I),Label$(I)[1,80]
7280    NEXT I
7290  ASSIGN #2 TO *
7300 RETURN
7310 Tape_err: E=ERRN
7320  IF E<>54 THEN GOTO 7360
7330  BEEP
7340  PRINT LIN(4);"ERROR 54: DUPLICATE FILE NAME...TRY AGAIN"
7350  GOTO 6560
7360  IF E<>55 THEN GOTO 7420
7370  BEEP
7380  PRINT LIN(4);TAB(10);"ERROR 55: DIRECTORY OVERFLOW...TRY A DIFFE
RENT TAPE"
7390  PRINT LIN(4);TAB(10);"AND PRESS CONT TO SAVE DATA SET"
7400  PRINT LIN(4);TAB(10);"NOTE: TAPE MUST BE INITIALIZED"
7410  GOTO 6810
7420  IF E<>53 THEN GOTO Error_end
7430  BEEP
7440  PRINT LIN(4);TAB(10);"ERROR 53: IMPROPER FILE NAME...TRY AGAIN"
7450  GOTO 6550
7460 Error_end: PRINT PAGE;LIN(5);TAB(20);"UNRECOVERABLE ERROR"
7470  Er=ERRL
7480  PRINT LIN(3);TAB(10);"ERROR ";E;"ON LINE";Er;" YOU MUST BEGIN PR
OGRAM AGAIN";LIN(8)
7490  GOSUB End_it
7500 Retrieve_graph: !
7510  PRINT PAGE
7520  CAT ":T14"
7530  PRINT LIN(2);"INPUT THE FILE NAME OF THE GRAPH TO BE RETRIEVED"
7540  INPUT D$
7550  C$=D$&":T14"
7560  ASSIGN #3 TO C$
7570  READ #3;A$,Pfile
7580  Pts=INT(25*200/Pfile)
7590  REDIM Npt(Pfile),F$(Pfile),X1(Pfile,Pts),Y1(Pfile,Pts)
7600  REDIM Ntemp(Pfile),Ftemp$(Pfile),Xtemp(Pfile,Pts),Ytemp(Pfile,Pt
s)
7610  READ #3;Npt(*),F$(*)
7620    FOR L1=1 TO Pfile
7630        FOR J=1 TO Npt(L1)
7640          READ #3;X1(L1,J)
7650        NEXT J
```

```
7660         FOR J=1 TO Npt(L1)
7670           READ #3;Y1(L1,J)
7680         NEXT J
7690       NEXT L1
7700    READ #3;Defaults,Log_ck,P1(*),Lt(*),Pc2(*),Pt,Xm,Ym,Xsize,Ysize,
Norm
7710    READ #3;Shade,Annot,Sd,File,Nt,Nx,Ny,Pc1,Pc3,Pc4,Scinot,Num_sd,X
mx,Xmn
7720    READ #3;Ymx,Ymn,Xt,Yt,Tsize,Lsize,Nsize,Asize,Xmult,Ymult,S,Opti
ons
7730    READ #3;X_max(*),X_min(*),Y_max(*),Y_min(*),Cm(*),Xdp,Ydp,Xmax,X
min
7740    READ #3;Ymax,Ymin,Sdx,Sdy,Nsd,L$(*),T$,X$,Y$,Norm(*),Shade(*),An
n
7750    READ #3;Shade$,Norm$,Frame,Axes,Number,Label
7760    IF Annot=0 THEN 7810
7770      FOR I=1 TO Ann+1
7780        READ #3;Xa(I),Ya(I),Plabel(I),Label$(I)
7790      NEXT I
7800    ASSIGN * TO #3
7810    CALL Plot_data
7820    RETURN
7830    !          ###############  END PROGRAM ROUTINE  ###############
7840 End_it: PRINT PAGE;LIN(8)
7850    PRINT TAB(33);"END OF PROGRAM"
7860    GOTO End
7870    RETURN
7880    ! ###################################################################
7890    ! #                                                                 #
7900    ! #                SET UP PARAMETERS FOR PLOT                       #
7910    ! #                                                                 #
7920    ! ###################################################################
7930 SUB Plot_data
7940    DEG
7950    COM F$(*),SHORT X1(*),Y1(*)
7960    COM INTEGER Npt(*),Defaults,Log_ck,Pfile,P1(*),Lt(*),Pc2(*)
7970    COM INTEGER Pt,Xm,Ym,Xsize,Ysize,Norm,Shade,Annot,Sd,File,Nt,Nx,
Ny
7980    COM INTEGER Pc1,Pc3,Pc4,Scinot,Num_sd,Ann,Frame,Axes,Label,Numbe
r
7990    COM SHORT Xmx,Xmn,Ymx,Ymn,Xt,Yt,Tsize,Lsize,Nsize,Asize,Xmult,Ym
ult,S
8000    COM SHORT X_max(*),X_min(*),Y_max(*),Y_min(*),Xa(*),Ya(*),Cm(*),
Xdp,Ydp
8010    COM SHORT Xmax,Xmin,Ymax,Ymin,Sdx,Sdy,Nsd,Options
8020    COM L$(*),T$,X$,Y$,V$,P$(*),Label$(*),Pen$(*),Shade$,Norm$
8030    COM X_max$(*),X_min$(*),Y_max$(*),Y_min$(*)
8040    COM INTEGER Norm(*),Shade(*),Plabel(*)
8050    Nfiles=Pfile
8060    IF Options=4 THEN 8230
```

```
8070   IF Defaults THEN 8170
8080   PRINT PAGE;LIN(6);TAB(10);"TO USE PLOT OPTIONS & SCALE PARAMETE
RS FROM"
8090   PRINT TAB(10);"THE PREVIOUS RUN...ENTER 1"
8100   An=0
8110   INPUT An
8120   IF An<>1 THEN GOTO 8170
8130   GOSUB Find_range
8140   IF (Log_ck=0) AND ((Pt=3) OR (Pt=4)) THEN GOSUB X_lin_to_log
8150   IF (Log_ck=0) AND ((Pt=2) OR (Pt=4)) THEN GOSUB Y_lin_to_log
8160   GOTO 8230
8170   GOSUB Set_defaults
8180   GOSUB Scale_type
8190   GOSUB Labels
8200   GOSUB Menu_1
8210   GOSUB Menu_2
8220   GOSUB Menu_3
8230   GOSUB Menu_4
8240 SUBEXIT
8250 Set_defaults:  !
8260  RESTORE 8280
8270  READ Tsize,Lsize,Nsize,Asize,Xsize,Ysize,Norm,Shade,Sd,Ym,Xm,Spt
,Pt,An,Annot
8280  DATA   1  ,  1  ,  1  ,  1  , 100 ,  60 ,  0 ,  0  , 0, 4, 4, 1,
 1 , 0 , 0
8290  READ Scinot,Dp_init,Ann,Frame,Axes,Number,Label
8300  DATA   0   ,   1   , 0 ,  1  , 1  ,   1  ,  1
8310  Defaults=0
8320  T$=" "
8330  X$=" "
8340  Y$=" "
8350  MAT P1=(0)
8360  MAT Lt=(1)
8370  MAT Cm=(1)
8380  MAT Pc2=(1)
8390  Pc1=1
8400  Pc3=1
8410  Pc4=1
8420  MAT Plabel=(1)
8430    FOR L=1 TO 40
8440      Label$(L)=" "
8450    NEXT L
8460  MAT Xa=(0)
8470  MAT Ya=(0)
8480    FOR L1=1 TO 10
8490      L$(L1)="*"
8500    NEXT L1
8510 RETURN
8520 Find_range: !
8530  Xmin=99999
```

```
8540  Xmax=-99999
8550  Ymin=99999
8560  Ymax=-99999
8570    FOR L1=1 TO Pfile
8580      X_min(L1)=99999
8590      X_max(L1)=-99999
8600      Y_min(L1)=99999
8610      Y_max(L1)=-99999
8620    NEXT L1
8630    FOR L1=1 TO Pfile
8640      FOR I=1 TO Npt(L1)
8650        IF X1(L1,I)>Xmax THEN Xmax=X1(L1,I)
8660        IF X1(L1,I)>X_max(L1) THEN X_max(L1)=X1(L1,I)
8670        IF X1(L1,I)<Xmin THEN Xmin=X1(L1,I)
8680        IF X1(L1,I)<X_min(L1) THEN X_min(L1)=X1(L1,I)
8690        IF Y1(L1,I)>Ymax THEN Ymax=Y1(L1,I)
8700        IF Y1(L1,I)>Y_max(L1) THEN Y_max(L1)=Y1(L1,I)
8710        IF Y1(L1,I)<Ymin THEN Ymin=Y1(L1,I)
8720        IF Y1(L1,I)<Y_min(L1) THEN Y_min(L1)=Y1(L1,I)
8730      NEXT I
8740    NEXT L1
8750 RETURN
8760 Y_lin_to_log: !
8770    FOR L1=1 TO Pfile
8780        FOR I=1 TO Npt(L1)
8790          Y1(L1,I)=LGT(Y1(L1,I))
8800        NEXT I
8810    NEXT L1
8820    Log_ck=1
8830 RETURN
8840 X_lin_to_log:!
8850    FOR L1=1 TO Pfile
8860        FOR I=1 TO Npt(L1)
8870          X1(L1,I)=LGT(X1(L1,I))
8880        NEXT I
8890    NEXT L1
8900    Log_ck=1
8910 RETURN
8920 Y_log_to_lin: !
8930    FOR L1=1 TO Pfile
8940        FOR I=1 TO Npt(L1)
8950          Y1(L1,I)=10^Y1(L1,I)
8960          Y1(L1,I)=FROUND(Y1(L1,I),INT(LGT(ABS(Y1(L1,I))))-4)
8970        NEXT I
8980    NEXT L1
8990 RETURN
9000 X_log_to_lin: !
9010    FOR L1=1 TO Pfile
9020      FOR I=1 TO Npt(L1)
9030          X1(L1,I)=10^X1(L1,I)
```

```
9040          X1(L1,I)=PROUND(X1(L1,I),INT(LGT(ABS(X1(L1,I))))-4)
9050        NEXT I
9060    NEXT L1
9070 RETURN
9080 Scale_type: ! ######## SUBROUTINE TO CHOOSE SCALE TYPE ########
9090  IF Pt>2 THEN GOSUB X_log_to_lin
9100  IF (Pt=2) OR (Pt=4) THEN GOSUB Y_log_to_lin
9110  IF (Pt=2) OR (Pt=4) THEN Ym=4
9120  GOSUB Find_range
9130 Scale_it: PRINT PAGE;LIN(2);TAB(23);"INPUT SCALE TYPE"
9140  PRINT LIN(2);TAB(10);"EXTREMES of this DATA SET are...";LIN(2)
9150  Xmin$=VAL$(Xmin)
9160  Xmax$=VAL$(Xmax)
9170  PRINT USING 9180;"Xmin = ";Xmin$,"Xmax = ";Xmax$
9180  IMAGE 9X,7A,20A,7A,20A
9190  Ymin$=VAL$(Ymin)
9200  Ymax$=VAL$(Ymax)
9210  PRINT LIN(1)
9220  PRINT USING 9180;"Ymin = ";Ymin$,"Ymax = ";Ymax$
9230  PRINT LIN(3);TAB(10);"You now must CHOOSE the TYPE of graph to P
LOT"
9240  PRINT LIN(1);TAB(15);"TO PLOT LINEAR ... ENTER 1"
9250  PRINT TAB(15);"TO PLOT X-LIN Y-LOG ... ENTER 2"
9260  PRINT TAB(15);"TO PLOT X-LOG Y-LIN ... ENTER 3"
9270  PRINT TAB(15);"TO PLOT LOG-LOG ... ENTER 4"
9280  Pt=0
9290  INPUT Pt
9300  IF (Pt>=1) AND (Pt<=4) THEN GOTO 9340
9310  BEEP
9320  INPUT "          Option not within range...TRY AGAIN",Pt
9330  GOTO 9300
9340  IF Pt=1 THEN 9550
9350  IF Pt=3 THEN GOTO Check_xmn
9360 Check_ymn: IF Ymin>0 THEN GOTO Ymn_ok
9370  PRINT PAGE;LIN(6);TAB(20);"Y VALUES ARE LESS THAN OR EQUAL TO ZE
RO."
9380  PRINT LIN(1);TAB(17);"THIS IS NOT ALLOWED FOR A LOG PLOT...TRY A
GAIN."
9390  PRINT LIN(6);TAB(30);"PRESS CONT TO TRY AGAIN"
9400  INPUT A1
9410  Pt=1
9420  GOTO Scale_it
9430 Ymn_ok: IF Pt=2 THEN 9520
9440 Check_xmn: IF Xmin>0 THEN 9520
9450  BEEP
9460  PRINT PAGE;LIN(8);TAB(20);"X VALUES ARE LESS THAN OR EQUAL TO ZE
RO."
9470  PRINT LIN(1);TAB(17);"THIS IS NOT ALLOWED FOR A LOG PLOT...TRY A
GAIN"
9480  PRINT LIN(2);TAB(30);"PRESS CONT TO TRY AGAIN"
```

```
9490  INPUT A1
9500  Pt=1
9510  GOTO Scale_it
9520  IF Pt>2 THEN GOSUB X_lin_to_log
9530  IF (Pt=2) OR (Pt=4) THEN GOSUB Y_lin_to_log
9540  IF Pt<>1 THEN Sd=0
9550  GOSUB Enter_scales
9560 RETURN
9570 Enter_scales: PRINT PAGE;LIN(2);TAB(25);"ENTER SCALE FOR X AXIS
"
9580  PRINT LIN(3);TAB(10);"X COORDINATE RANGE: ";Xmin;" TO ";Xmax;LIN
(2)
9590  PRINT TAB(10);"ENTER the MINIMUM and MAXIMUM values for the X AX
IS"
9600  IF (Pt=1) OR (Pt=2) THEN GOTO 9850
9610  PRINT LIN(1);TAB(10);"Since this is a LOG axis, values must be
 a POWER of 10 (i.e. .01,100)"
9620  INPUT Xmn,Xmx
9630  IF Xmx-Xmn>0 THEN GOTO 9680
9640  BEEP
9650  PRINT LIN(2);TAB(10);"The scaling range that you have input for
the X axis"
9660  PRINT TAB(10);"is less than or equal to 0...TRY AGAIN"
9670  GOTO 9620
9680  IF Xmn>0 THEN GOTO 9740
9690  BEEP
9700  PRINT LIN(2);"MINIMUM must be greater than 0 for a LOG plot...
TRY AGAIN"
9710  PRINT LIN(2);"PRESS CONT TO CONTINUE"
9720  INPUT A1
9730  GOTO 9620
9740  Dmin=INT(LGT(Xmn))-LGT(Xmn)
9750  Dmax=INT(LGT(Xmx))-LGT(Xmx)
9760  IF (Dmin=0) AND (Dmax=0) THEN GOTO 9810
9770  BEEP
9780  PRINT LIN(2);TAB(10);"The values you entered were";Xmn;"and";Xmx
9790  PRINT TAB(10);"One of these is not a POWER of TEN"
9800  GOTO 9620
9810  Xm=LGT(Xmx)-LGT(Xmn)
9820  Nx=INT(LGT(Xmx)-LGT(Xmn))
9830  Xt=2
9840  GOTO 9940
9850  INPUT Xmn,Xmx
9860  IF Xmx-Xmn>0 THEN GOTO 9910
9870  BEEP
9880  PRINT LIN(2);TAB(10);"The scaling range that you have input for
the X axis"
9890  PRINT TAB(10);"is less than or equal to 0...TRY AGAIN"
9900  GOTO 9850
9910  IF N1=2 THEN Xm=4
```

```
9920  Xt=(Xmx-Xmn)/(5*Xm)
9930  Nx=INT((Xmx-Xmn)/(Xt*5))
9940  PRINT PAGE;LIN(2);TAB(25);"ENTER SCALE FOR Y AXIS"
9950  PRINT LIN(3);TAB(10);"Y COORDINATE RANGE: ";Ymin;" TO ";Ymax;LIN
(2)
9960  PRINT TAB(10);"ENTER the MINIMUM and MAXIMUM values for the Y AX
IS"
9970  IF (Pt=1) OR (Pt=3) THEN GOTO 10200
9980  PRINT LIN(1);TAB(10);"Since this is a LOG axis, values must be
 a POWER of 10 (i.e. .01,100)"
9990  INPUT Ymn,Ymx
10000 IF Ymx-Ymn>0 THEN GOTO 10050
10010 BEEP
10020 PRINT LIN(2);TAB(10);"The scaling range that you have input for
the Y axis"
10030 PRINT TAB(10);"is less than or equal to 0...TRY AGAIN"
10040 GOTO 9990
10050 IF Ymn>0 THEN GOTO 10090
10060 BEEP
10070 PRINT LIN(2);TAB(10);"MINIMUM must be greater than 0 for a LOG
 plot...TRY AGAIN"
10080 GOTO 9990
10090 Dmin=INT(LGT(Ymn))-LGT(Ymn)
10100 Dmax=INT(LGT(Ymx))-LGT(Ymx)
10110 IF (Dmin=0) AND (Dmax=0) THEN GOTO 10160
10120 BEEP
10130 PRINT LIN(2);TAB(10);"The values you entered were ";Ymn;" and ";
Ymx
10140 PRINT TAB(10);"Since this is a LOG axis, values must be a POWE
R of 10 (i.e. .01,100)"
10150 GOTO 9990
10160 Ym=LGT(Ymx)-LGT(Ymn)
10170 Ny=INT(LGT(Ymx)-LGT(Ymn))
10180 Yt=1
10190 GOTO 10290
10200 INPUT Ymn,Ymx
10210 IF Ymx-Ymn>0 THEN GOTO 10260
10220 BEEP
10230 PRINT LIN(2);TAB(10);"The scaling range that you have input for
the Y axis"
10240 PRINT TAB(10);"is less than or equal to 0...TRY AGAIN"
10250 GOTO 10200
10260 IF M1=2 THEN Ym=4
10270 Yt=(Ymx-Ymn)/(5*Ym)
10280 Ny=INT((Ymx-Ymn)/(Yt*5))
10290 RETURN
10300 Labels:! ########## INPUT LABELS AND TITLE  ####################
10310 PRINT PAGE;LIN(2);TAB(20);"INPUT TITLE AND AXES LABELS"
10320 PRINT LIN(4);TAB(12);"INPUT TITLE FOR PLOT...UP TO 30 CHARACTERS
"
```

```
10330 INPUT T$
10340 PRINT LIN(3);TAB(12);"INPUT LABEL FOR THE X AXIS...UP TO 20 CHAR
ACTERS"
10350 INPUT X$
10360 PRINT LIN(2);TAB(12);"INPUT LABEL FOR THE Y AXIS...UP TO 20 CHAR
ACTERS"
10370 INPUT Y$
10380 PRINT LIN(4);TAB(5);"PRESS CONT TO CONTINUE"
10390 INPUT Y$
10400 RETURN
10410 Tick_count:! ############  CHANGE MAJOR TICK COUNT  ##############
##
10420 PRINT PAGE
10430 PRINT LIN(4);TAB(25);"CHANGE TICK INTERVALS"
10440 PRINT LIN(3);TAB(10);"YOU MAY CHANGE THE NUMBER OF MAJOR TICK IN
TERVALS"
10450 PRINT LIN(1);TAB(25);"FOR LINEAR AXES ONLY"
10460 PRINT LIN(3);TAB(24);"PRESS CONT TO CONTINUE"
10470 INPUT A1
10480 IF Pt>2 THEN GOTO 10670
10490 PRINT PAGE;TAB(23);"X AXIS MAJOR TICK INTERVAL";LIN(3)
10500 PRINT TAB(10);"The RANGE that you have chosen for the X AXIS is
";Xmx-Xmn
10510 PRINT LIN(2);TAB(10);"         MAJOR TICK INTERVAL =  RANGE
"
10520 PRINT TAB(40);"MAJOR TICKS";LIN(1)
10530 PRINT TAB(10);"How many MAJOR TICKS do you want on X AXIS..."
10540 PRINT LIN(1);TAB(10);"DEFAULT is 4";LIN(3)
10550 INPUT Xm
10560 Xt=(Xmx-Xmn)/(5*Xm)
10570 Xt=PROUND(Xt,INT(LGT(ABS(Xt)))-2)
10580 Nx=Xm
10590 Xm$=VAL$(5*Xt)
10600 Xt$=VAL$(Xt)
10610 PRINT USING 10620;"X MAJOR TICK INTERVAL = ";Xm$;"X MINOR TICK I
NTERVAL = ";Xt$
10620 IMAGE 9X,24A,6A,2X,24A,6A
10630 PRINT LIN(2);TAB(10);"TO TRY AGAIN...ENTER 1"
10640 A1=0
10650 INPUT A1
10660 IF A1=1 THEN GOTO 10490
10670 IF (Pt=2) OR (Pt=4) THEN RETURN
10680 PRINT PAGE;TAB(23);"Y AXIS MAJOR TICK INTERVAL";LIN(3)
10690 PRINT TAB(10);"The RANGE that you have chosen for the Y AXIS is
";Ymx-Ymn
10700 PRINT LIN(2);TAB(10);"         MAJOR TICK INTERVAL =  RANGE
"
10710 PRINT TAB(40);"MAJOR TICKS";LIN(1)
10720 PRINT TAB(10);"How many MAJOR TICKS do you want on Y AXIS..."
10730 PRINT LIN(1);TAB(10);"DEFAULT is 4";LIN(3)
```

```
10740 INPUT Ym
10750 Yt=(Ymx-Ymn)/(5*Ym)
10760 Yt=PROUND(Yt,INT(LGT(ABS(Yt)))-2)
10770 Ny=Ym
10780 Ym$=VAL$(5*Yt)
10790 Yt$=VAL$(Yt)
10800 PRINT USING 10620;"Y MAJOR TICK INTERVAL = ";Ym$;"Y MINOR TICK I
NTERVAL = ";Yt$
10810 PRINT LIN(2);TAB(10);"TO TRY AGAIN...ENTER 1"
10820 A1=0
10830 INPUT A1
10840 IF A1=1 THEN GOTO 10690
10850 RETURN
10860 Menu_1:  PRINT PAGE
10870 PRINT TAB(25);"MENU 1: REVEIW INPUT PARAMETERS";LIN(1)
10880 PRINT "OPTION #"
10890 PRINT "  (1)    TITLE:   ";T$
10900 PRINT LIN(1);"          LABELS -  X AXIS: ";X$
10910 PRINT "                    Y AXIS: ";Y$
10920 PRINT LIN(1);"  (2)    SCALE TYPE: ";P$(Pt);LIN(1)
10930 Xmn$=VAL$(Xmn)
10940 Xmx$=VAL$(Xmx)
10950 Ymn$=VAL$(Ymn)
10960 Ymx$=VAL$(Ymx)
10970 PRINT USING 11040;"(3)    SCALE :";"  X MIN = ";Xmn$,"X MAX =
";Xmx$
10980 PRINT USING 11050;" ";"Y MIN = ";Ymn$,"Y MAX = ";Ymx$
10990 PRINT LIN(1)
11000 IF Pt<3 THEN PRINT "  (4)    MAJOR TICKS -  X AXIS: ";Xm;"  MA
JOR TICK INTERVALS OF ";Xt*5
11010 IF Pt>2 THEN PRINT "  (4)    MAJOR TICKS -  X AXIS: ";Xm;"  MA
JOR TICKS"
11020 IF (Pt=1) OR (Pt=3) THEN PRINT TAB(25);"Y AXIS: ";Ym;"  MAJOR TI
CK INTERVALS OF ";Yt*5
11030 IF (Pt=2) OR (Pt=4) THEN PRINT TAB(25);"Y AXIS: ";Ym;"  MAJOR T
CKS"
11040 IMAGE 2X,22A,10A,16A,9A,9A
11050 IMAGE 2X,22A,8A,16A,9A,9A
11060 PRINT LIN(1);"TO CHANGE ANY OF THESE PARAMETERS...ENTER OPTION #
"
11070 PRINT LIN(1);"PRESS CONT TO CONTINUE"
11080  A1=0
11090  INPUT A1
11100  IF A1=0 THEN RETURN
11110  ON A1 GOSUB Labels,Scale_type,Enter_scales,Tick_count
11120 GOTO Menu_1
11130 RETURN
11140 Menu_2:PRINT PAGE;TAB(22);"MENU 2: DIMENSION/PLOT OPTIONS";LIN
(2)
11150 PRINT USING 11160;"PLOT OPTIONS";"DIMENSION OPTIONS"
```

```
11160 IMAGE 9X,12A,27X,17A
11170 PRINT "OPTION #";TAB(41);"OPTION #"
11180 IMAGE 2X,29A,4D
11190 IMAGE 2X,27A,4D
11200 Asize$=VAL$(Asize)
11210 IF Annot=0 THEN PRINT USING 11230;"(1)   ANNOTATION:  NO";""
11220 IF Annot<>0 THEN PRINT USING 11230;"(1)   ANNOTATION: YES - SI
ZE = ";Asize$
11230 IMAGE #,2X,33A,7A
11240 PRINT "  (6)   DIMENSIONS - X AXIS:";Xsize
11250 PRINT TAB(62);"Y AXIS:";Ysize
11260 IF Norm=0 THEN PRINT USING 11280;"  (2)   NORMALIZE: NO",""
11270 IF Norm<>0 THEN PRINT USING 11280;"  (2)   NORMALIZE - FILE: "
;Norm$
11280 IMAGE #,27A,17A
11290 PRINT "(7)   TITLE SIZE:  ";Tsize;LIN(1)
11300 IF NOT Scinot THEN PRINT USING 11320;"  (3)   SCIENTIFIC NOTATI
ON: NO"
11310 IF Scinot THEN PRINT USING 11320;"  (3)   SCIENTIFIC NOTATION:
 YES"
11320 IMAGE #,44A
11330 PRINT "(8)   LABEL SIZE:  ";Lsize;LIN(1)
11340 IMAGE #,44A
11350 PRINT USING 11340;"  (4)   STANDARD "
11360 PRINT " (9)   NUMBER SIZE: ";Nsize
11370 IF Sd<>0 THEN PRINT "         DEVIATION: +/-";Num_sd;"SIGMA ERR
OR BAR";LIN(1)
11380 IF Sd=0 THEN PRINT "         DEVIATION: NO";LIN(1)
11390 IF Shade=0 THEN PRINT "  (5)   SHADING: NO"
11400 IF Shade<>0 THEN PRINT USING 11410;"  (5)   SHADING - FILES: "
;Shade$
11410 IMAGE 27A,30A
11420 PRINT LIN(1);"  TO CHANGE ANY OF THESE PARAMETERS...INPUT NUMBER
 THAT"
11430 PRINT "  CORRESPONDS TO OPTION #"
11440 PRINT LIN(1);"PRESS CONT TO CONTINUE"
11450 A1=3
11460 INPUT A1
11470 IF A1=0 THEN RETURN
11480 ON A1 GOSUB Annotation,Normalize,Sci_not,Std_dev,Shading,Dimensi
ons,Title_size,Label_size,Number_size
11490 GOTO Menu_2
11500 RETURN
11510 ! ####################  STANDARD DEVIATION  ###################
11520 Std_dev:PRINT PAGE;LIN(4);TAB(28);"STANDARD DEVIATION"
11530 IF Et=1 THEN GOTO 11580
11540 PRINT LIN(3);TAB(12);"STANDARD DEVIATION MAY BE USED ON A LINEAR
 SCALE ON Y"
11550 PRINT LIN(2);TAB(29);"PRESS CONT TO CONTINUE"
11560 PAUSE
```

```
11570 RETURN
11580 PRINT LIN(4);TAB(15);"TO DISPLAY STD DEV ERROR BAR ON GRAPH ENTE
R 1"
11590 Sd=0
11600 INPUT Sd
11610 IF Sd=0 THEN RETURN
11620 Crt=0
11630 Nsd=SQR(20000*(Ymax-Ymin))/20000
11640 PRINT LIN(4);TAB(18);"ENTER THE VALUE FOR 1 STANDARD DEVIATION"
11650 INPUT Nsd
11660 PRINT LIN(3);TAB(8);"ENTER THE NUMBER OF STANDARD DEVIATIONS TO
PLOT...BETWEEN 1 AND 3"
11670 INPUT Num_sd
11680 IF (Num_sd>=1) AND (Num_sd<=3) THEN RETURN
11690 BEEP
11700 INPUT "THE NUMBER OF STANDARD DEVIATIONS TO PLOT MUST BE BETWEEN
 1 AND 3...TRY AGAIN",Num_sd
11710 GOTO 11680
11720 RETURN
11730 Sci_not: ! ###############  SCIENTIFIC NOTATION  ##############
11740 PRINT PAGE;LIN(3);TAB(25);"SCIENTIFIC NOTATION"
11750 PRINT LIN(2);TAB(10);"User may have SCIENTIFIC NOTATION on the L
INEAR AXES"
11760 PRINT LIN(1);TAB(8);"LOG AXES will AUTOMATICALLY be labelled as
POWERS of 10"
11770 PRINT LIN(2);"NOTE: If SCIENTIFIC NOTATION is used on the Y AX
IS, the Y AXIS LABEL "
11780 PRINT TAB(7);"will not be printed on the CRT or on the DIGITAL P
LOTTER if the"
11790 PRINT TAB(7);"default NUMBER SIZE of 1 is used.  To print the Y
AXIS LABEL, choose"
11800 PRINT TAB(7);"a NUMBER SIZE of .8 or SMALLER.  On the DIGITAL PL
OTTER, the"
11810 PRINT TAB(7);"situation may also be remedied by choosing a PLOT
SIZE of .3 or SMALLER."
11820 Scinot=0
11830 PRINT LIN(3);TAB(20);"TO USE SCIENTIFIC NOTATION ENTER 1 "
11840 INPUT Scinot
11850 RETURN
11860 Title_size:! #############  INPUT TITLE SIZE  ##################
##
11870 PRINT PAGE;LIN(4);TAB(30);"TITLE SIZE"
11880 PRINT LIN(5);TAB(15);"INPUT MULTIPLIER BETWEEN 0 AND 3 FOR TITLE
"
11890 PRINT LIN(2);TAB(15);"DEFAULT IS 1"
11900 INPUT Tsize
11910 RETURN
11920 Label_size:! ############ INPUT LABEL SIZE  ###################
11930 PRINT PAGE;LIN(4);TAB(30);"AXES LABEL SIZE"
11940 PRINT LIN(5);TAB(10);"INPUT MULTIPLIER BETWEEN 0 AND 3 FOR X AND
```

```
 Y LABEL SIZE"
11950 PRINT LIN(2);TAB(10);"DEFAULT IS 1"
11960 INPUT Lsize
11970 RETURN
11980 ! ##################### INPUT NUMBER SIZE  ####################
11990 Number_size: PRINT PAGE;LIN(4);TAB(30);"NUMBER SIZE"
12000 PRINT LIN(2);TAB(15);"ENTER MULTIPLIER BETWEEN 0 AND 2...DEFAULT
 IS 1"
12010 INPUT Nsize
12020 RETURN
12030 Dimensions:! ############  INPUT DIMENSIONS FOR PLOT  ##########
######
12040 PRINT PAGE;LIN(4);TAB(28);"DIMENSION PLOT"
12050 PRINT LIN(2);TAB(10);"DEFAULT SIZE FOR PLOTTING IS 100 X UNITS B
Y 60 Y UNITS"
12060 PRINT LIN(2);TAB(20);"ENTER SIZE FOR X AXIS...1 TO 120"
12070 INPUT Xsize
12080 PRINT LIN(2);TAB(20);"ENTER SIZE FOR Y AXIS...1 TO 80"
12090 INPUT Ysize
12100 RETURN
12110 Annotation:  ! ##########  ANNOTATION AND SIZE  ###############
##
12120   PRINT PAGE;LIN(2);TAB(36);"ANNOTATION"
12130   PRINT LIN(3);TAB(20);"TO PLACE ANNOTATION ON YOUR GRAPH...ENTE
R 1"
12140   Annot=0
12150   INPUT Annot
12160   IF Annot=0 THEN RETURN
12170   Cnt=0
12180   PRINT LIN(3);TAB(10);"WARNING: If you wish to use ANNOTATION
 on the DIGITAL PLOTTER"
12190   PRINT LIN(1);TAB(19);"you must FIRST PLOT graph on the CRT"
12200   PRINT LIN(3);TAB(20);"Input MULTIPLIER between 0 and 2 for the
 ANNOTATION"
12210   PRINT LIN(1);TAB(28);"CHARACTER SIZE...DEFAULT is 1"
12220   Asize=1
12230   INPUT Asize
12240   IF (Asize>=0) AND (Asize<=2) THEN RETURN
12250   BEEP
12260   INPUT "             CHARACTER size MULTIPLIER must be between
 0 and 2...TRY AGAIN",Asize
12270   GOTO 12240
12280 RETURN
12290 Normalize:! ##########  NORMALIZE DATA FILES ############
12300 PRINT PAGE;LIN(2);TAB(29);"NORMALIZE"
12310 PRINT LIN(2);TAB(22);"DATA RANGES FOR FILES ARE:";LIN(2)
12320 IMAGE 10X,10A,12A,12A,12A,12A
12330 PRINT USING 12320;"FILE # ","X-MIN","X-MAX","Y-MIN","Y-MAX"
12340   FOR L1=1 TO Pfile
12350     L1$=VAL$(L1)
```

```
12360      X_min$(L1)=VAL$(X_min(L1))
12370      Y_min$(L1)=VAL$(Y_min(L1))
12380      X_max$(L1)=VAL$(X_max(L1))
12390      Y_max$(L1)=VAL$(Y_max(L1))
12400      PRINT USING 12410;L1$;X_min$(L1);X_max$(L1);Y_min$(L1);Y_max
$(L1)
12410      IMAGE 12X,8A,12A,12A,12A,12A
12420    NEXT L1
12430 PRINT LIN(3);TAB(11);"NOTE: THE NEW VALUES FOR DATA PAIRS WILL
 BE ROUNDED"
12440 PRINT TAB(17);"TO FOUR SIGNIFICANT DIGITS"
12450 PRINT LIN(2);TAB(18);"TO NORMALIZE A DATA FILE ... ENTER 1"
12460 A1=0
12470 INPUT A1
12480 IF A1<>1 THEN RETURN
12490 Norm=1
12500 INPUT "           ENTER FILE #, MULTIPLIER FOR X DATA, MULTIPLIER
 FOR Y DATA",File,Xmult,Ymult
12510    FOR K=1 TO Npt(File)
12520      X1(File,K)=X1(File,K)*Xmult
12530      IF X1(File,K)=0 THEN GOTO 12550
12540      X1(File,K)=PROUND(X1(File,K),INT(LGT(ABS(X1(File,K))))-3)
12550      Y1(File,K)=Y1(File,K)*Ymult
12560      IF Y1(File,K)=0 THEN GOTO 12580
12570      Y1(File,K)=PROUND(Y1(File,K),INT(LGT(ABS(Y1(File,K))))-3)
12580    NEXT K
12590 Norm(File)=File
12600 I=1
12610 K=2
12620    FOR L1=1 TO Pfile
12630      IF Norm(L1)=0 THEN GOTO 12680
12640      IF L1>9 THEN K=3
12650      Norm$[I,I+K]="#"&VAL$(L1)&","
12660      I=I+K+1
12670      J=L1
12680    NEXT L1
12690 IF J<10 THEN Norm$[I-1]=" "
12700 GOSUB Find_range
12710 ! BEEP!&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
12720 ! PAUSE !&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
12730 GOTO Normalize
12740 RETURN
12750 Shading:! #######  SHADING FOR A SINGLE LINE GRAPH  ###########
12760 PRINT PAGE;LIN(3);TAB(30);"SHADING"
12770 PRINT LIN(3);TAB(15);"YOU MAY HAVE A PARTIAL FILLING OF THE SPAC
E"
12780 PRINT TAB(15);"BELOW YOUR CURVE IN THE DATA PLOT"
12790 PRINT LIN(1);TAB(9);"NOTE: CHOOSING THIS WILL MEAN THAT THE PL
OT WILL TAKE"
12800 PRINT TAB(15);"3 TIMES AS LONG"
```

```
12810 PRINT LIN(2);TAB(15);"TO CHOOSE THIS OPTION ... ENTER 1"
12820 Shade=0
12830 INPUT Shade
12840 IF Shade=0 THEN RETURN
12850 PRINT PAGE
12860 PRINT LIN(2);TAB(25);"FILE # - DESCRIPTOR"
12870   FOR L1=1 TO Pfile
12880     L1$=VAL$(L1)
12890     PRINT USING 12900;L1$;F$(L1)
12900     IMAGE 26X,7A,20A
12910     BEEP
12920     Shade(L1)=0
12930     INPUT "          TO SHADE THIS FILE...ENTER 1 - ELSE PRESS C
ONT",Shade(L1)
12940   NEXT L1
12950 I=1
12960 K=2
12970   FOR L1=1 TO Pfile
12980     IF Shade(L1)<>1 THEN GOTO 13030
12990     IF L1>9 THEN K=3
13000     Shade$[I,I+K]="#"&VAL$(L1)&","
13010     I=I+K+1
13020     J=L1
13030   NEXT L1
13040 IF J<10 THEN Shade$[I-1]=" "
13050 RETURN
13060 Menu_3:PRINT PAGE;TAB(25);"MENU 3: PLOT-TYPE OPTIONS";LIN(2)
13070   FOR L1=1 TO Pfile
13080     IF P1(L1)=3 THEN PRINT TAB(20);"FILE #";L1;"  PLOT HISTOGRAM
"
13090     IF (P1(L1)=0) OR (P1(L1)=2) THEN PRINT TAB(20);"FILE #";L1;"
  LINE TYPE #    ";Lt(L1)
13100     IF P1(L1)=1 THEN PRINT TAB(20);"FILE #";L1;"  SYMBOL =
  ";L$(L1)
13110     IF P1(L1)=2 THEN PRINT TAB(31);"SYMBOL =        ";L$(L1)
13120     IF (P1(L1)=2) OR (P1(L1)=1) THEN PRINT TAB(31);"SYMBOL MULT
=  ";Cm(L1)
13130   NEXT L1
13140 PRINT LIN(2);TAB(17);"TO CHANGE ANY OF THESE FILES...ENTER 1"
13150 PRINT LIN(1);TAB(25);"PRESS CONT TO CONTINUE"
13160 A1=0
13170 INPUT A1
13180 IF A1=0 THEN RETURN
13190 GOSUB Plot_types
13200 GOTO Menu_3
13210 RETURN
13220 Plot_types:! ########  INPUT PLOT TYPES  ##################
13230 !
13240   FOR L1=1 TO Pfile
13250     PRINT PAGE;LIN(2)
```

```
13260      PRINT USING 13270;"FILE  #";L1,":";F$(L1)
13270      IMAGE 22X,6A,DD,A,2X,20A
13280      PRINT LIN(2);TAB(10);"FOR PLOTTING DATA YOU HAVE THE FOLLOWI
NG OPTIONS...";LIN(2)
13290      PRINT TAB(20);"ENTER 0...TO PLOT LINES"
13300      PRINT TAB(20);"ENTER 1...TO PLOT SYMBOLS"
13310      PRINT TAB(20);"ENTER 2...TO PLOT BOTH LINES AND SYMBOLS"
13320      PRINT TAB(20);"ENTER 3...TO PLOT A HISTOGRAM-TYPE PLOT"
13330      INPUT P1(L1)
13340      IF (P1(L1)>=0) AND (P1(L1)<=3) THEN GOTO 13380
13350      BEEP
13360      PRINT LIN(2);TAB(15);"OPTION # IS NOT 0 THROUGH 3...TRY AGAI
N"
13370      GOTO 13330
13380      IF P1(L1)=1 THEN GOTO 13430
13390      IF P1(L1)=3 THEN GOTO 13470
13400      PRINT LIN(2);TAB(10);"INPUT LINE TYPE #...ref. page 18 of RO
M graphics manual"
13410      INPUT Lt(L1)
13420      IF P1(L1)<>2 THEN GOTO 13470
13430      PRINT LIN(2);TAB(10);"ENTER THE SYMBOL TO BE USED";LIN(2)
13440      INPUT L$(L1)
13450      PRINT TAB(10);"ENTER THE MULTIPLIER OF THE PRESENT CHARACTER
 SIZE FOR SYMBOLS"
13460      INPUT Cm(L1)
13470    NEXT L1
13480 RETURN
13490 Menu_4:! ################ MENU 4 - PLOT IT WHERE?  ############
13500 PRINT PAGE;LIN(2);TAB(25);"MENU 4: OUTPUT MEDIA"
13510 PRINT LIN(2);"OPTION #";TAB(43);"OPTION #"
13520 PRINT "  (1)  CRT";TAB(45);"  (4)  MENU 1:INPUT PARMETERS"
13530 PRINT LIN(2);"  (2)  THERMAL PRINTER";TAB(45);"  (5)  MENU 2:
DIMENSIONS/OPTIONS"
13540 PRINT LIN(2);"  (3)  DIGITAL PLOTTER";TAB(45);"  (6)  MENU 3:
PLOT TYPES"
13550 PRINT LIN(4);"INPUT OPTION # THAT CORRESPONDS TO WHAT YOU WANT T
O DO"
13560 PRINT "OR PRESS CONT TO GO BACK TO PROGRAM OPTIONS"
13570 X1=3
13580 INPUT X1
13590 IF (X1>=0) AND (X1<=6) THEN GOTO 13630
13600 BEEP
13610 INPUT "OPTION CHOSEN IS NOT BETWEEN 1 AND 6...TRY AGAIN",X1
13620 GOTO 13590
13630 IF X1=0 THEN RETURN
13640 IF X1>3 THEN ON X1-3 GOSUB Menu_1,Menu_2,Menu_3
13650 IF X1>3 THEN GOTO Menu_4
13660 IF (X1=1) OR (Crt=1) OR (Options=4) THEN 13710
13670 IF (Annot<>1) AND (Sd<>1) THEN 13710
13680 BEEP
```

```
13690 INPJT "ANNOTATION OR STAN. DEV. MUST BE PLOTTED ON CRT FIRST...T
RY AGAIN",X1
13700 GOTJ 13590
13710 IF (X1>0) AND (X1<4) THEN ON X1 GOSUB Crt,Printer,Plotter
13720 GOTJ Menu_4
13730 RETJRN
13740 Crt:! ####################  PLOT ON CRT  ######################
13750 PLOTTER IS 13,"GRAPHICS"              ! Plot on CRT
13760  GRAPHICS                             ! graphics screen
13770  Crt=1                                ! Set flag that graph has be
en
13780  S1=S
13790  S=1                                  ! plotted on CRT.
13800  Xdp1=Xdp                              ! Set digital plotter param
eters
13810  Ydp1=Ydp
13820  Xdp=0
13830  Ydp=0                                ! to their defaults
13840  GOSUB Plot                           ! and plot.
13850  PAJSE                                ! Pause to let user look at
graph
13860  EXIT GRAPHICS                        ! and return to alpha screen
13870  Xdp=Xdp1
13880  Ydp=Ydp1
13890  S=S1
13900 RETJRN
13910 !
13920 !
13930 Printer:! ################ PRINT ON THERMAL PRINTER  ###########
####
13940  DUMP GRAPHICS                        ! Dump whatever is on the gr
aphics
13950  RETURN                               ! screen to the internal pri
nter
13960 !
13970 !
13980 Plotter:! ##################  DIGITAL PLOTTER OPTIONS  #########
########
13990 Dp=1                                  ! Set digital plotter flag
14000 PLOTTER IS 7,5,"9872A"                ! Address the plotter
14010 IF Dp_init=1 THEN GOSUB Init          ! If defaults are used, init
ialize pen
14020 GOSJB Size                            ! Input size of plot, plot m
edium, and
14030 GOSJB Plotter_menu                    ! plot option and annotation
 colors
14040 GOSJB Plot                            ! and plot
14050 IF Pdraft=0 THEN PEN 0                ! Put pen back if drafting p
en is not
14060 EXIT GRAPHICS                         ! used and return to MENU_4
```

```
14070 Dp=0                                    ! Reset plotter flag.
14080 RETURN
14090 Init:Pc1=1
14100 MAT Pc2=(1)
14110 Pc3=1
14120 Pc4=1
14130 MAT Plabel=(1)
14140 Pc5=1
14150 Pdraft=0
14160 Dp_init=0
14170 RETURN
14180 Size:PRINT PAGE;LIN(2);TAB(28);"INPUT PLOT SIZE"
14190 PRINT LIN(2);TAB(15);"You now have a chance to pick the plot siz
e"
14200 PRINT LIN(1);TAB(15);"Plot size must be a number between 0 and
 1"
14210 PRINT LIN(3);TAB(15);"EXAMPLES:"
14220 PRINT LIN(1);TAB(20);"SIZE=1.00...Full plotter limits"
14230 PRINT TAB(20);"SIZE=0.65...Standard 8 1/2 x 11 inch page"
14240 PRINT TAB(20);"SIZE=0.00...Single point on the page"
14250 INPUT "                 INPUT PLOT SIZE ?",S
14260 IF (S>=0) AND (S<=1) THEN RETURN
14270 BEEP
14280 INPUT "                 PLOT SIZE is not between 0 and 1...PRESS
CONT AND TRY AGAIN",A1
14290 GOTO 14250
14300 RETURN
14310 Plotter_menu:PRINT PAGE;LIN(2);TAB(30);"DIGITAL PLOTTER";LIN(2
)
14320 PRINT TAB(10);"There are three output medium options for the dig
ital plotter:"
14330 PRINT LIN(1);TAB(17);"OPTION #"
14340 PRINT TAB(19);"(1)   FELT TIP PENS - NORMAL QUALITY"
14350 PRINT TAB(19);"(2)   FELT TIP PENS - PUBLICATION QUALITY"
14360 PRINT TAB(19);"(3)   TRANSPERANCIES"
14370 PRINT TAB(19);"(4)   DRAFTING PEN";LIN(1)
14380 PRINT TAB(10);"Using defaults, the time it take to plot one grap
h using"
14390 PRINT TAB(10);"using one data file is:";LIN(1)
14400 PRINT TAB(18);"(1) Normal Quality - about two minutes"
14410 PRINT TAB(18);"(2) Publication quality - twice as long"
14420 PRINT TAB(18);"(3) Tansparencies - twice as long"
14430 PRINT TAB(18);"(4) Drafting pen  - four times as long.";LIN(2)
14440 Do=1
14450 INPUT "          INPUT the OPTION # that you would like to use",D
o
14460 IF (Do>=1) AND (Do<=4) THEN GOTO 14500
14470 BEEP
14480 INPUT "           OPTION # NOT WITHIN RANGE...PRESS CONT AND TR
Y AGAIN",A1
```

```
14490 GOTO 14450
14500 ON Do GOSUB Normal,Pub,Pub,Draft
14510 RETURN
14520 Normal:OUTPUT 7,5;"VS 8"              ! Plot fast (8 cm./sec.)
14530 GOSUB Colors                          ! and go get colors
14540 RETURN
14550 Pub:OUTPUT 7,5;"VS 3"                 ! Plot slow (3 cm./sec.)
14560 GOSUB Colors                          ! and get colors
14570 RETURN
14580 Draft:OUTPUT 7,5;"VS 1"               ! Plot at drafting speed (1 c
m./sec.)
14590 GOSUB Init
14600 Pdraft=1                              ! Set dfrafting flag
14610 PRINT PAGE;LIN(4);TAB(25);"DRAFTING PEN"
14620 PRINT LIN(4);TAB(20);"LOAD THE DRAFTING PEN NOW"
14630 PRINT LIN(4);TAB(10);"PRESS CONT TO CONTINUE"
14640 PAUSE
14650 RETURN
14660 Colors:PRINT PAGE;LIN(2);TAB(30);"PLOT COLORS"
14670 PRINT LIN(1);TAB(20);"PEN #1 - BLACK   PEN #3 - GREEN"
14680 PRINT TAB(20);"PEN #2 - BLUE    PEN #4 - RED"
14690 PRINT LIN(2);TAB(15);"(1) TITLE: ";Pen$(Pc3);TAB(39);"(2) AXE
S LABELS: ";Pen$(Pc4)
14700 PRINT LIN(1);TAB(15);"(3) AXES AND TICK MARKS: ";Pen$(Pc1)
14710 K=3
14720 PRINT LIN(1);TAB(15);"(4) FILE #"
14730   FOR L1=1 TO Pfile
14740     E$=F$(L1)[1]
14750     Pen$=""
14760     IF Pc2(L1)<>0 THEN Pen$=Pen$(Pc2(L1))
14770     PRINT TAB(21);L1;" - ";Pen$;": ";F$(L1)
14780   NEXT L1
14790 Op=Fil=P=0
14800 INPUT "          TO CHANGE A COLOR...ENTER OPTION # - else PRESS
CONT TO CONTINUE",Op
14810 IF Op=0 THEN GOTO 15020
14820 IF (Op>=1) AND (Op<=4) THEN GOTO 14860
14830 BEEP
14840 INPUT "    OPTION # NOT WITHIN RANGE...PRESS CONT AND TRY AGAI
N",A1
14850 GOTO 14800
14860 IF Op<>4 THEN GOTO 14920
14870 INPUT "                INPUT FILE #",Fil
14880 IF (Fil>=1) AND (Fil<=Pfile) THEN GOTO 14920
14890 BEEP
14900 INPUT "    FILE # NOT WITHIN RANGE...PRESS CONT AND TRY AGAIN"
,A1
14910 GOTO 14870
14920 INPUT "                INPUT NEW PEN #",P
14930 IF (P>=0) AND (P<=4) THEN GOTO 14970
```

```
14940 BEEP
14950 INPUT "    PEN # NOT WITHIN 0 AND 4...PRESS CONT AND TRY AGAIN
",A1
14960 GOTO 14920
14970 ON Op GOSUB Tit,Lab,Ax,Files
14980 A1=0
14990 INPUT "    TO REVEIW NEW COLORS...ENTER 1 - PRESS CONT TO CONT
INUE",A1
15000 IF A1=1 THEN GOTO Colors
15010 GOTO 14790
15020 IF Annot<>1 THEN RETURN
15030 PRINT PAGE;LIN(2);TAB(27);"ANNOTATION COLORS"
15040 PRINT LIN(1);TAB(20);"PEN #1 - BLACK   PEN #3 - GREEN"
15050 PRINT TAB(20);"PEN #2 - BLUE    PEN #4 - RED";LIN(1)
15060 PRINT TAB(20);"LABEL #"
15070   FOR K=2 TO Ann
15080     Pen$=""
15090     IF Plabel(K)<>0 THEN Pen$=Pen$(Plabel(K))
15100     PRINT USING 15110;K-1;")";Pen$;" - ";Label$(K)
15110     IMAGE 20X,2D,A,3X,5A,3A,20A
15120   NEXT K
15130 Fil=P=0
15140 INPUT "    TO CHANGE A COLOR...ENTER LABEL # - else PRESS CONT
 to CONTINUE",Fil
15150 IF Fil=0 THEN RETURN
15160 IF (Fil>=0) AND (Fil<=Ann-1) THEN GOTO 15210
15170 BEEP
15180 DISP "    LABEL # NOT WITHIN 0 AND";Ann-1;"...PRESS CONT AND T
RY AGAIN"
15190 PAUSE
15200 GOTO 15140
15210 INPUT "               INPUT NEW PEN #",P
15220 IF (P>=0) AND (P<=4) THEN GOTO 15260
15230 BEEP
15240 INPUT "    PEN # NOT WITHIN 0 AND 4...PRESS CONT AND TRY AGAIN
",A1
15250 GOTO 15210
15260 Plabel(Fil+1)=P
15270 A1=0
15280 INPUT "    TO REVEIW NEW COLORS...ENTER 1 - PRESS CONT TO CONT
INUE",A1
15290 IF A1=1 THEN GOTO 15030
15300 GOTO 15130
15310 RETURN
15320 Tit:Pc3=P                          ! Set new pen for title
15330 RETURN
15340 Lab:Pc4=P                          ! Set new pen for axes labels
15350 RETURN
15360 Ax:Pc1=P                           ! Set new pen for axes and numb
ers
```

```
15370 RETURN
15380 Files:Pc2(Fil)=P                    ! Set new pen color for file #
Fil
15390 RETURN
15400 ! ###################################################################
15410 ! #                                                                 #
15420 ! #                          PLOT DATA                              #
15430 ! #                                                                 #
15440 ! ###################################################################
15450 Plot:!
15460 IF Pt=1 THEN GOTO 15550 ! TAKE LOGS OF SCALE RANGES FOR THE LOG
AXES
15470 IF Pt=3 THEN GOTO 15500
15480 Ymx=LGT(Ymx)
15490 Ymn=LGT(Ymn)
15500 IF Pt=2 THEN GOTO 15550
15510 Xmx=LGT(Xmx)
15520 Xmn=LGT(Xmn)
15530  !  PLOT AREA = 20*PLOT SIZE + PLOTTER DISPLACEMENTS (Xdp,Ydp)
                              FOR LOWER X AND LEFT Y AXES
15540  !            x (20+SIZE OF AXIS (Xsize,Ysize))*PLOT SIZE+DISPLA
CEMENTS                        FOR THE TOP X AND RIGHT Y SIDES
15550 LOCATE 20*S+Xdp,(20+Xsize)*S+Xdp,20*S+Ydp,(20+Ysize)*S+Ydp
15560 SCALE Xmn,Xmx,Ymn,Ymx ! Scale graph into user units
15570 IF Dp AND NOT Pdraft THEN PEN Pc1
15580 LINE TYPE 1
15590 IF Frame THEN FRAME                 ! Draw FRAME using a solid L
INE TYPE
15600 IF Axes THEN GOSUB Axes             ! Draw TIC MARKS in USER UNI
TS
15610 IF Dp AND NOT Pdraft THEN PEN Pc1
15620 IF Number THEN GOSUB Number         ! LABEL axes NUMBERS in GRAP
HICS UNITS
15630 IF Dp AND NOT Pdraft THEN PEN Pc3
15640 IF Label THEN GOSUB Label           ! LABEL TITLE and AXES LABEL
S in GRAPHIC UNITS
15650   FOR L1=1 TO Pfile                 ! PLOT FILES in USER UNITS
15660     IF Dp AND NOT Pdraft THEN PEN Pc2(L1)
15670     LOCATE 20*S+Xdp,(20+Xsize)*S+Xdp,20*S+Ydp,(20+Ysize)*S+Ydp
15680     SCALE Xmn,Xmx,Ymn,Ymx
15690     IF P1(L1)=3 THEN GOSUB Histogram
15700     IF (P1(L1)=0) OR (P1(L1)=2) THEN GOSUB Lines
15710     IF (P1(L1)=1) OR (P1(L1)=2) THEN GOSUB Symbols
15720     IF Shade AND (P1(L1)<>3) THEN GOSUB Shade_it
15730   NEXT L1
15740 IF Dp AND NOT Pdraft THEN PEN Pc1
15750 SETGU
15760 IF Sd THEN GOSUB Stan_dev    ! PLOT STANDARD DEVIATION in GRAPHI
CS UNITS
15770 IF Annot THEN GOSUB Annotate ! PLOT ANNOTATION in GRAPHICS UNITS
```

```
15780 IF Pt=1 THEN GOTO 15850
15790 IF Pt=3 THEN GOTO 15820       ! Convert SCALE RANGES back to LINE
AR values
15800 Ymx=10^Ymx                    ! for LOG axes
15810 Ymn=10^Ymn
15820 IF Pt=2 THEN GOTO 15850
15830 Xmx=10^Xmx
15840 Xmn=10^Xmn
15850 RETURN
15860 Axes:! ############################  DRAW AXES  ################
####
15870   LINE TYPE 1
15880   Xi=(Xmx-Xmn)/90                 ! Compute size of X minor ti
c
15890   Yi=(Ymx-Ymn)/70                 ! Compute size of Y minor ti
c
15900   IF Pt=1 THEN GOTO 16320
15910   IF Pt=3 THEN GOTO 16090
15920   FOR K=Ymn TO Ymx-1              ! Draw tics for Y log - left
 side
15930     MOVE Xmn,K
15940     DRAW Xmn+Xi*2,K               ! Draw major tic
15950       FOR L=2 TO 9
15960         MOVE Xmn,K+LGT(L)         ! Draw minor tics
15970         DRAW Xmn+Xi,K+LGT(L)
15980       NEXT L
15990   NEXT K
16000   FOR K=Ymn TO Ymx-1              ! Y log - right side
16010     MOVE Xmx,K
16020     DRAW Xmx-Xi*2,K
16030       FOR L=2 TO 9
16040         MOVE Xmx,K+LGT(L)
16050         DRAW Xmx-Xi,K+LGT(L)
16060       NEXT L
16070   NEXT K
16080   IF Pt=2 THEN GOTO 16290
16090   FOR K=Xmn TO Xmx-1              ! Draw tics for X log - bott
om side
16100     MOVE K,Ymn
16110     DRAW K,Ymn+Yi*2               ! Major tics
16120       FOR L=2 TO 9
16130         MOVE K+LGT(L),Ymn         ! Minor tics
16140         DRAW K+LGT(L),Ymn+Yi
16150       NEXT L
16160   NEXT K
16170   FOR K=Xmn TO Xmx-1              ! Top side
16180     MOVE K,Ymx
16190     DRAW K,Ymx-Yi*2
16200       FOR L=2 TO 9
16210         MOVE K+LGT(L),Ymx
```

```
16220          DRAW K+LGT(L),Ymx-Yi
16230        NEXT L
16240    NEXT K
16250    IF Pt=4 THEN RETURN
16260    AXES 0,Yt,Xmn,Ymn,5,5,3            ! Y linear axes - 5 minor ti
cs between                                              major tics on ea
ch axis with a
16270    AXES 0,Yt,Xmx,Ymx,5,5,3            ! tic size=3
16280   RETURN
16290    AXES Xt,0,Xmn,Ymn,5,5,3            ! X linear axes
16300    AXES Xt,0,Xmx,Ymx,5,5,3
16310   RETURN
16320    AXES Xt,Yt,Xmn,Ymn,5,5,3           ! X and Y linear axes
16330    AXES Xt,Yt,Xmx,Ymx,5,5,3
16340 ! AXES 0,Yt,Xmn,Ymn,5,5,3 !&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
16350 RETURN
16360 Number:! ########################  NUMBER AXES  ################
##
16370 SETGU
16380 LOCATE 0,130*S,0,100*S
16390 CSIZE 3.75*S*Nsize*(Xsize/100)
16400 Xs=3.75*Nsize*9/15*(Xsize/100)    ! Compute width of numbers
16410 Ys=3.75*Nsize*(Xsize/100)         ! Compute hieght of numbers
16420 LORG 4
16430    FOR I=0 TO Nx
16440      IF Pt<3 THEN GOTO 16530   —  ! Skip to 15820 if not log axis
16450      MOVE 20*S+Xsize*S*I/Nx+Xdp,(20-1.5*Ys)*S+Ydp   !MOVE TO CENT
ER
16460      V$="10"                      ! Place number in the middle of
 the
16470      LABEL V$                     ! major tick and half the heigh
t below
16480      U$=VAL$(Xmn+I)               ! the X axis.  Place exponent h
alf way up
16490      Lu=LEN(U$)                   ! the height of the number and
in the
16500      MOVE (20+(Lu+2)*Xs/2)*S+Xsize*S*I/Nx+Xdp,(20-Ys)*S+Ydp
16510      LABEL U$                     ! middle of the entire lenght o
f number
16520      GOTO 16770                   ! i.e. "10U$"
16530      Xnum=Xmn+Xt*5*I              ! If linear axis, compute numbe
r value
16540      IF Xnum=0 THEN Xexp=0        ! and value of the exponent
16550      IF Xnum=0 THEN GOTO 16570
16560      Xexp=INT(LGT(ABS(Xnum)))
16570      IF Scinot<>1 THEN GOTO 16700
16580      MOVE 20*S+5*Xsize*I*Xt*S/(Xmx-Xmn)+Xdp,(20-1.5*Ys)*S+Ydp
16590      Xnum=DROUND(Xnum/10^Xexp,2)    ! Round number to d.d
16600     FIXED 1
16610      V$=VAL$(Xnum)&"x10"            ! Label mantissa
```

```
16620      STANDARD
16630      LABEL V$
16640      Lv=LEN(V$)
16650      U$=VAL$(Xexp)
16660      Lu=LEN(U$)                          ! Place exp. the same a for lo
g
16670      MOVE (20+(Lv+Lu)*Xs/2)*S+5*Xsize*I*Xt*S/(Xmx-Xmn)+Xdp,(20-Ys
)*S+Ydp
16680      LABEL U$
16690      GOTO 16770
16700      MOVE 20*S+5*Xsize*I*Xt*S/(Xmx-Xmn)+Xdp,(20-1.5*Ys)*S+Ydp
16710      Xnum=PROUND(Xnum,Xexp-3)            ! Round number to 3 signigican
t digits
16720      V$=VAL$(Xnum)                       ! and add leading 0 if necessa
ry
16730      IF (Xnum<1) AND (Xnum>0) THEN V$="0"&V$
16740      IF (Xnum>-1) AND (Xnum<0) THEN V$="-0"&VAL$(ABS(Xnum))
16750 !    LORG 7
16760      LABEL V$
16770    NEXT I
16780 LORG 2
16790 IF (Pt=2) OR (Pt=4) THEN GOTO 16870 ! Skip to log section for lo
g axis
16800 Len=0
16810    FOR I=0 TO Ny
16820      GOSUB Ynumber                       ! Find the length of the long
est numbe^
16830      Ln=LEN(V$)
16840      IF Ln>Len THEN Len=Ln
16850    NEXT I
16860 Ly=3
16870    FOR I=0 TO Ny                         ! Loop for number of major ti
cs
16880      IF (Pt=1) OR (Pt=3) THEN GOTO 16980 ! Skip to linear section
16890      Ly=LEN(VAL$(Ymr))                   ! Find length of longest expo
nent
16900      IF LEN(VAL$(Ymx))>Ly THEN Ly=LEN(VAL$(Ymx))     ! Place "10"
 width of
16910      MOVE (20-((Ly+2)*Xs+.5*Ys))*S+Xdp,20*S+Ysize*S*I/Ny+Ydp ! en
tire number away
16920      V$="10"                             ! from the left Y axis side
16930      LABEL V$                            ! Label exp. the width of lon
gest exp.
16940      MOVE (20-(Ly*Xs+.5*Ys))*S+Xdp,(20+Ys/2)*S+Ysize*S*I/Ny+Ydp !
 away from the
16950      V$=VAL$(Ymn+I)                      ! left Y axis side
16960      LABEL V$
16970      GOTO 17200
16980      IF Scinot<>1 THEN GOTO 17170    ! Skip to standard numbers
16990      Ynum=Ymn+Yt*5*I                     ! Compute the value of the nu
```

```
mber
17000      IF Ynum=0 THEN Yexp=0           ! and the exponent
17010      IF Ynum=0 THEN GOTO 17040
17020      Yexp=INT(LGT(ABS(Ynum)))
17030      Ynum=PROUND(Ynum/10^Yexp,-1)    ! Compute mantissa  d.d
17040      FIXED 1
17050      V$=VAL$(Ynum)&"x10"
17060      STANDARD
17070      U$=VAL$(Yexp)
17080      Lv=LEN(V$)                      ! Place number the width of t
he whole
17090      Lu=LEN(U$)                      ! number away from the Y axis
17100      MOVE (20-(Lv+Lu)*Xs-.5*Ys)*S+Xdp,20*S+Ysize*S*I/Ny+Ydp
17110      LABEL V$                        ! Place exp. the width of the
 exp. away
17120      MOVE (20-Lu*Xs-.5*Ys)*S+Xdp,(20+Ys/2)*S+Ysize*S*I/Ny+Ydp ! f
rom Y axis
17130      LABEL U$
17140      Lyt=Lv+Lu                       ! Find length of longest numb
er
17150      IF Lyt>Ly THEN Ly=Lyt
17160      GOTO 17200
17170      GOSUB Ynumber                   ! For standard numbers, get Y
 number
17180      MOVE (20-Len*Xs-.5*Ys)*S+Xdp,20*S+5*Ysize*Yt*I*S/(Ymx-Ymn)+Y
dp
17190      LABEL V$                        ! Place it the width of the l
ongest
17200    NEXT I                            ! number away from the Y axis
17210 RETURN
17220 Ynumber: Ynum=Ymn+Yt*5*I             ! Compute value of the number
17230      IF Ynum=0 THEN GOTO 17250
17240      Ynum=DROUND(Ynum,3)             ! round to 3 significant digi
ts
17250      V$=VAL$(Ynum)                   ! and add leading 0 if necess
ary
17260      IF (Ynum<1) AND (Ynum>0) THEN V$="0"&V$
17270      IF (Ynum>-1) AND (Ynum<0) THEN V$="-0"&VAL$(ABS(Ynum))
17280 RETURN
17290 Label:! ####################  LABEL AXES AND TITLE  ############
####
17300 SETGU
17310 LOCATE 0,130*S,0,100*S                ! Set clip units to whole pl
ot  size
17320 LORG 4
17330 CSIZE 5*S*Tsize                       ! Define title size
17340 IF Dp=0 THEN GOTO 17370
17350   FOR I=0 TO 0                        ! Make title a little thicke
r
17360      A=I/10                           ! on the digital plotter
```

```
17370     MOVE (20+Xsize/2)*S+Xdp+A,(25+Ysize)*S+Ydp ! Move title to t
he middle
17380     IF Dp THEN PEN Pc3                  ! of X axis and 5 units abov
e graph
17390     LABEL T$
17400     IF Dp=0 THEN GOTO 17430
17410   NEXT I
17420   FOR I=0 TO 0                          ! Make axes labels thicker o
f the
17430     LORG 6                              ! plotter
17440     CSIZE 5*S*Lsize                     ! Define label character siz
e
17450     MOVE (20+Xsize/2)*S+Xdp+A,(20-2.5*Ys)*S+Ydp  ! Place X label
 in the
17460     IF Dp THEN PEN Pc4                  ! middle of X axis and 1 let
ter
17470     LABEL X$                            ! size below the numbers
17480     LORG 4
17490     MOVE (20-Len*Xs-1.5*Ys)*S+Xdp,(20+Ysize/2)*S+Ydp+A
17500     IF Scinot=1 THEN MOVE (20-(Ly*Xs+1.5*Ys))*S+Xdp,(20+Ysize/2)
*S+Ydp+I/10
17510     IF (Pt=2) OR (Pt=4) THEN MOVE (20-((Ly+2)*Xs+1.5*Ys))*S+Xdp,
(20+Ysize/2)*S+Ydp+I/10
17520     LDIR 90                             ! Place Y label in the middl
e of the
17530     LABEL Y$                            ! Y axis and 1 letter size t
o the left
17540     LDIR 0                              ! of the Y numbers and rotat
e
17550     IF (Dp=0) OR (Pdraft=1) THEN RETURN
17560   NEXT I
17570 RETURN
17580 Histogram:! ############ PLOT HISTOGRAM ###############
17590     Xii=(Xmx-Xmn)/Xsize*.25*(1/S)    ! If shading is used, make th
e shade                                                .25 graphic units
 apart
17600     Xi=99999
17610       FOR I=2 TO Npt(L1)              ! Find the smallest distance
between
17620         J=X1(L1,I)-X1(L1,I-1)         ! any 2 points
17630         IF J<Xi THEN Xi=J
17640       NEXT I
17650     Xi=(Xi-20*Xii)/2                   ! ALGORITHM: Draw a rectangl
e with:
17660       FOR I=1 TO Npt(L1)              ! HEIGHT= Y value (Y1(L1,I))
17670         MOVE X1(L1,I)-Xi,Ymn          ! WIDTH= ± Xi
17680         DRAW X1(L1,I)-Xi,Y1(L1,I)     ! Xi = (Smallest distance bet
ween any
17690         DRAW X1(L1,I)+Xi,Y1(L1,I)     !       2 points - 1 graphic
unit
```

```
17700         DRAW X1(L1,I)+Xi,Ymn       !       (4*Xii)) /2
17710         IF Shade<>1 THEN GOTO 17760
17720         FOR Ix=X1(L1,I)-Xi+Xii TO X1(L1,I)+Xi-Xii STEP Xii!&&&&&
&&&&&&&&&&&&&&&&&&&&&&&&&&&&
17730           MOVE Ix,Ymn
17740           DRAW Ix,Y1(L1,I)          ! Shade Histogram with lines
1/4
17750         NEXT Ix                     ! graphic unit apart
17760       NEXT I
17770     RETURN
17780     !
17790     !
17800 Lines:! ######################  PLOT LINES  ##################
17810     MOVE X1(L1,1),Y1(L1,1)          ! Move pen to first data pair
17820     LINE TYPE Lt(L1)                ! Set line type chosen in PLO
T_TYPES
17830       FOR J=1 TO Npt(L1)
17840         DRAW X1(L1,J),Y1(L1,J)
17850       NEXT J
17860     RETURN
17870       !
17880       !
17890 Symbols:! #####3################  PLOT SYMBOLS  ###############
#
17900     LINE TYPE 1                     ! Make sure symbol is draw sol
id
17910     CSIZE Cm(L1)*3.3*S              ! Set character size - 3.3 is
default
17920     LORG 5                          ! Label symbol in the center o
f point
17930       FOR I=1 TO Npt(L1)            ! Make sure point is within th
e frame
17940         IF (X1(L1,I)<Xmn) OR (X1(L1,I)>Xmx) THEN GOTO 17980
17950         IF (Y1(L1,I)<Ymn) OR (Y1(L1,I)>Ymx) THEN GOTO 17980
17960         MOVE Y1(L1,I),Y1(L1,I)
17970         LABEL L$(L1)                ! Move pen and label symbol
17980       NEXT I
17990     RETURN
18000 !
18010 !
18020 Shade_it:! ############################  SHADING  ##############
###
18030   LINE TYPE 1
18040   Xi=(Xmx-Xmn)/Xsize*.25*(1/S) ! Make shade lines 1/4 graphic un
it apart
18050   Stop=INT((X1(L1,Npt(L1))-X1(L1,1))/Xi)       ! Compute # of sh
ade lines to draw
18060   Xf=X1(L1,1)                   ! Initialize x value of first sha
de line
18061   K=1
```

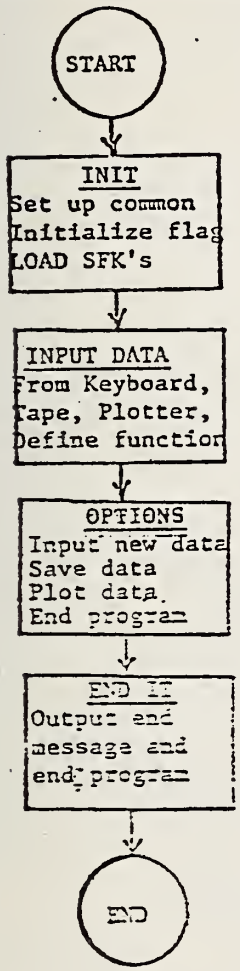
```
18070     FOR I=0 TO Stop
18071       X1=X1(L1,K)
18072       X2=X1(L1,K+1)
18073       Y1=Y1(L1,K)
18074       Y2=Y1(L1,K+1)
18120       IF Y2<>Y1 THEN GOTO 18150 !If Y values of adjacent points
                                                  are equal get next po
int
18130       Yf=Y1
18140       GOTO 18160
18150       Yf=(Xf-X1)/(X2-X1)*(Y2-Y1)+Y1
18160       MOVE Xf,Ymn                  ! Draw shade line
18170       DRAW Xf,Yf                   ! Get next shade line
18180       Xf=Xf+Xi
18181       IF Xf>=X2 THEN K=K+1
18190     NEXT I
18200 RETURN
18210 Stan_dev:! ###################  DRAW +/- STD. DEV. ############
####
18220 IF Dp THEN 18350                    ! If plotter is used skip inpu
t part
18230 EXIT GRAPHICS
18240 PRINT PAGE;LIN(1);TAB(20);"PLOT STANDARD DEVIATION"
18250 PRINT LIN(2);TAB(10);"THE PROGRAM IS NOW READY TO PLOT THE SIGMA
 ERROR BAR."
18260 PRINT LIN(1);TAB(10);"(1) PRESS CONT TO GO BACK TO THE PLOT ON
 THE CRT"
18270 PRINT TAB(10);"(2) POSITION THE CURSOR AT THE BOTTOM OF WHERE TH
E ERROR BAR WILL"
18280 PRINT TAB(15);"BE PLOTTED"
18290 PRINT LIN(1);TAB(10);"(3) PRESS CONT"
18300 PRINT LIN(1);TAB(10);"THE PROGRAM WILL THEN PLOT THE ERROR BAR O
N THE CRT"
18310 PRINT LIN(1);TAB(10);"PRESS CONT TO RETURN TO MENU 4: OUTPUT M
EDIA"
18320 INPUT A1
18321 GRAPHICS
18330 POINTER 60,70,2                     ! Allow user to digitize whe
re the
18340 DIGITIZE Sdx,Sdy                    ! error bar will be plotted
18350 Nsd_gu=Ysize/(Ymx-Ymn)*Nsd          ! Convert user unit error ba
r into
18360 MOVE Sdx*S+Xdp,Sdy*S+Ydp            ! graphic units
18370 DRAW Sdx*S+Xdp,(Sdy+2*Num_sd*Nsd_gu)*S+Ydp      ! Draw error bar
18380 MOVE (Sdx-.2)*S+Xdp,(Sdy+2*Num_sd*Nsd_gu)*S+Ydp ! Draw ends on t
he bar
18390 DRAW (Sdx+.2)*S+Xdp,(Sdy+2*Num_sd*Nsd_gu)*S+Ydp
18400 MOVE (Sdx-.2)*S+Xdp,Sdy*S+Ydp
18410 DRAW (Sdx+.2)*S+Xdp,Sdy*S+Ydp
18420 LORG 2                              ! Label number of standard d
```

```
eviations
18430 MOVE (Sdx+2)*S+Xdp,(Sdy+Num_sd*Nsd_gu)*S+Ydp ! in the middle of
the bar
18440 CSIZE 3.5*S
18450 U=3.5*(9/15)*S                    ! Find size of character in
graphic
18460 U$=" + "&VAL$(Num_sd)&"o"         ! units
18470 LABEL U$
18480 MOVE (Sdx+2)*S+Xdp,(Sdy+Num_sd*Nsd_gu+.3)*S+Ydp
18490 LABEL " _"                        ! Label minus sign
18500 MOVE (Sdx+2.25)*S+4*U+Xdp,(Sdy+Num_sd*Nsd_gu+.2)*S+Ydp  .
18510 LABEL "-"                         ! Make "o" into a sigma by a
dding a
18520 RETURN                            ! bar on top of it
18530 Annotate:! ##################  ANNOTATION  ####################
####
18540 CSIZE 4*S*Asize                   ! Set character size
18550 LORG 2                            ! Label from rightmost charac
ter
18560 IF Dp=1 THEN 18700                ! On plotter, skip input sec
tion
18561 WAIT 500
18570 EXIT GRAPHICS                     ! Force user to press key to t
rigger                                          alpha screen
18580 PRINT PAGE;LIN(4);"WE ARE NOW READY TO LET YOU PROVIDE ANNOTATIO
N FOR THE"
18590 PRINT "GRAPH WHICH YOU HAVE JUST DRAWN";LIN(1)
18600 PRINT "POSITION THE CURSOR TO THE LEFT EDGE OF THE POSITION WHIC
H YOU "
18610 PRINT "WANT TO START YOUR LABEL AND PRESS CONT";LIN(1)
18620 PRINT "THE SCREEN WILL PAUSE TO THE KEYBOARD MODE AND YOU THEN E
NTER"
18630 PRINT "THE ANNOTATION THAT YOU WANT";LIN(2)
18640 PRINT "CONTINUE AS MANY TIMES AS YOU WANT"
18650 PRINT LIN(2);"TO EXIT ANNOTATION...ENTER SAME CURSOR POINT TWICE
"
18660 PRINT LIN(2);"...TO START ANNOTATION PRESS CONT"
18670 PAUSE                             ! Force user to go back to gr
aphics
18671 GRAPHICS
18680 CSIZE .5
18690 POINTER 60,70,2                   ! screen and set cursor
18700   FOR L=2 TO 30                   ! Up to 29 labels
18710     ! If on plotter check if point was digitized twice
18720     IF (Dp=1) AND ((Xa(L)=Xa(L-1)) AND (Ya(L)=Ya(L-1))) THEN RET
URN
18730     ! If not on plotter, digitize next label position
18740     IF Dp=0 THEN DIGITIZE Xa(L),Ya(L)
18750     ! If this is the same position, exit annotation loop
18760     IF (Dp=0) AND (Xa(L)=Xa(L-1)) AND (Ya(L)=Ya(L-1)) THEN RETUR
```

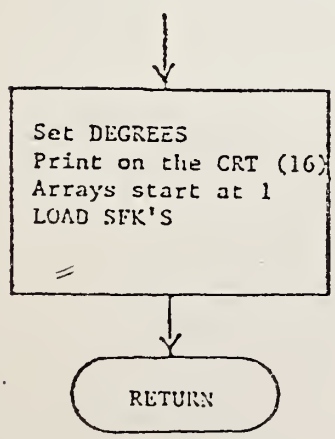
```
N
18770      ! else move pen to label position
18780      MOVE Xa(L)*S+Xdp,Ya(L)*S+Ydp
18790      ! If on CRT, enter label
18800      IF Dp=0 THEN INPUT "INPUT ANNOTATION LABEL",Label$(L)
18810      ! Pick up pen on plotter for the next label
18820      IF Dp=1 THEN PEN Plabel(L)
18830      ! Label annotation
18840      CSIZE 4*S*Asize                        ! Set character size
18850      LABEL Label$(L)
18860   !  CSIZE .5 &&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
18870      ! Count number of labels for use in annotation color$
18880      Ann=L
18890    NEXT L
18900 RETURN
18910 SUBEND
18920 ! ###############  END PROGRAM ROUTINE  ###############
18930 End_it:PRINT PAGE;LIN(15)
18940 PRINT TAB(25);"END OF PROGRAM"
18950 GOTO End
18960 RETURN 7005
```

APPENDIX D: FLOW CHARTS

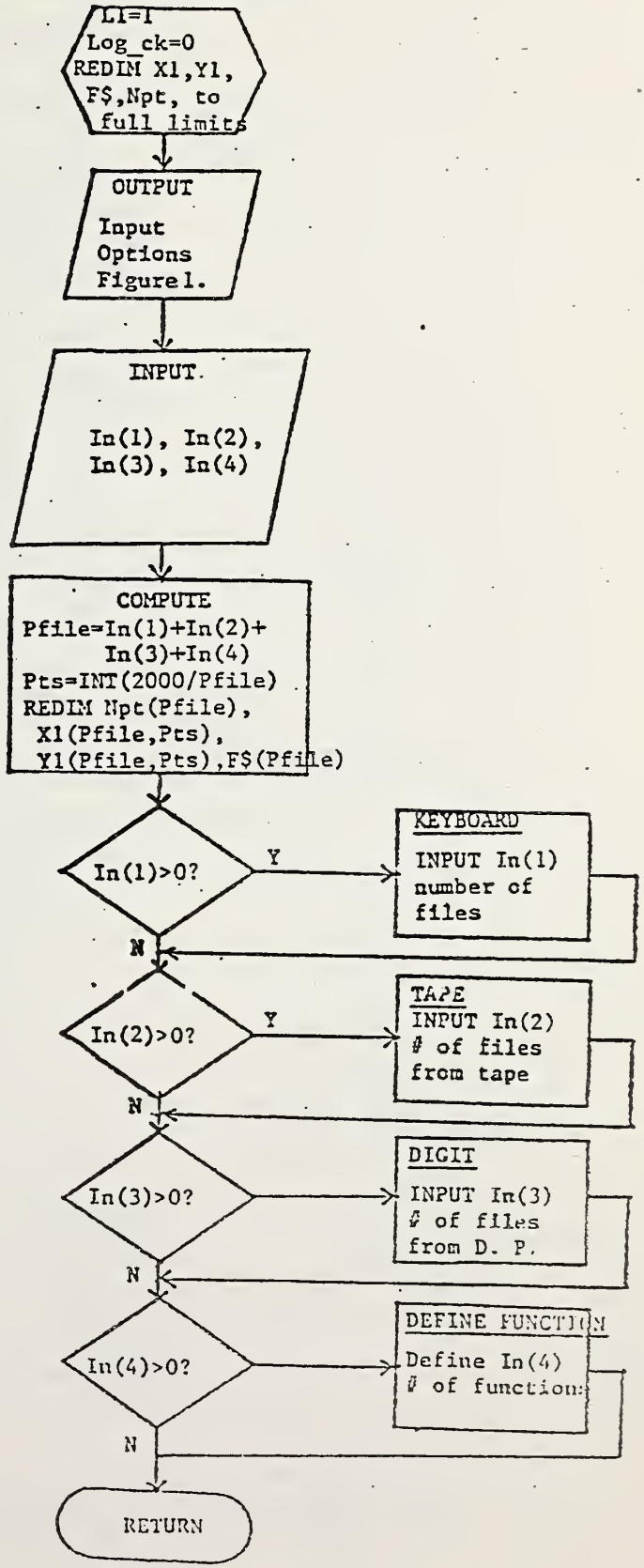
PLOT PROGRAM DRIVER

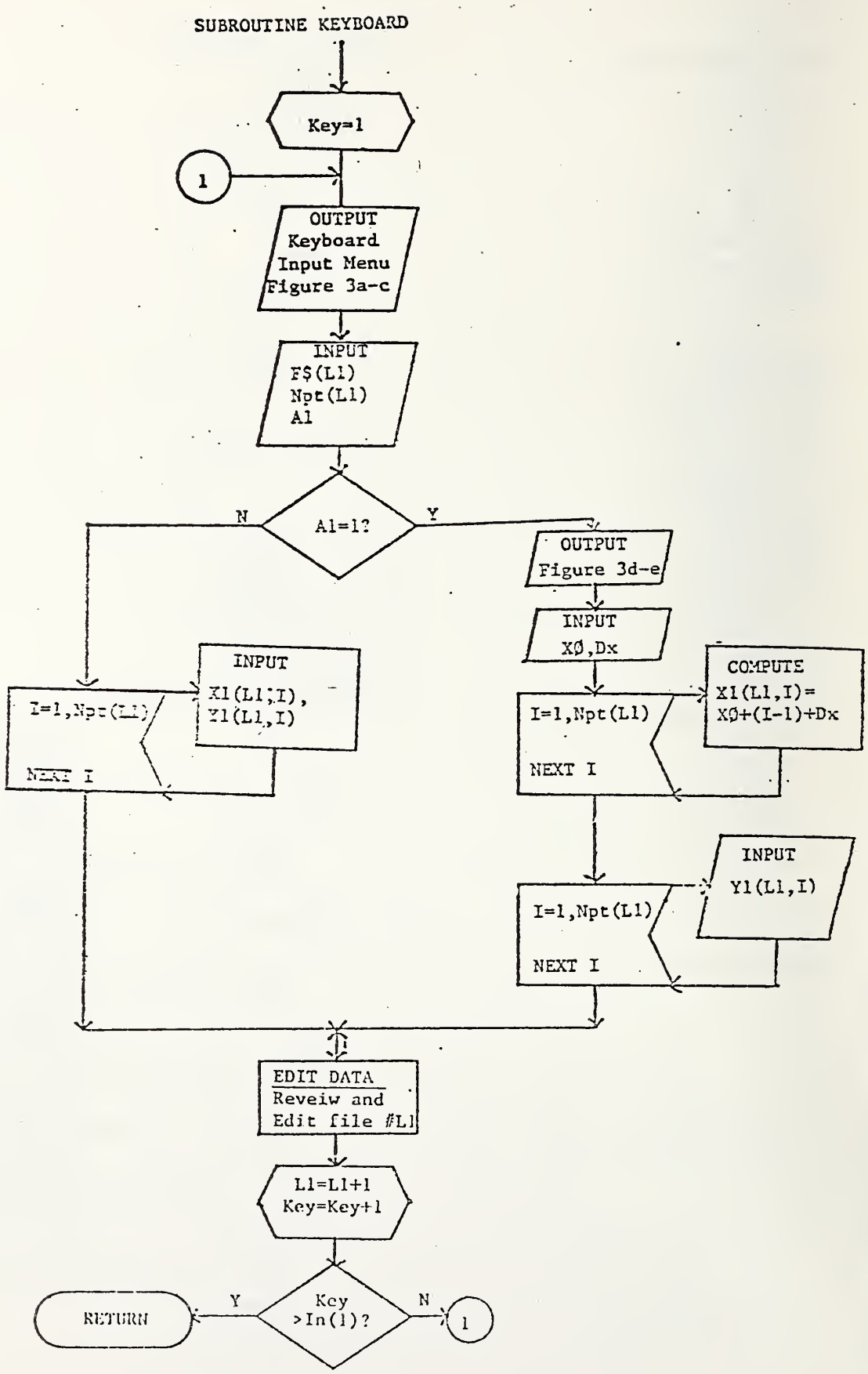


SUBROUTINE INIT

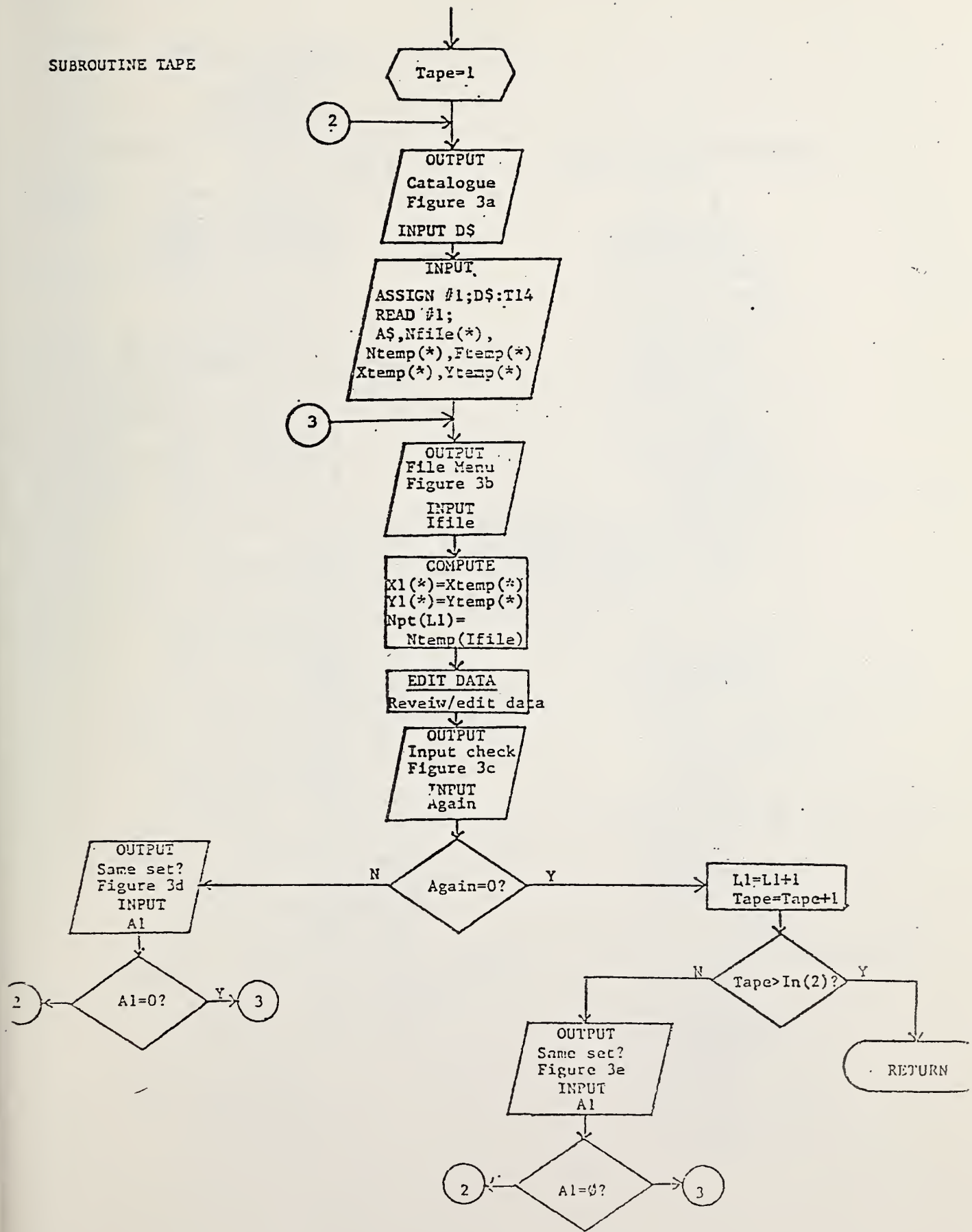


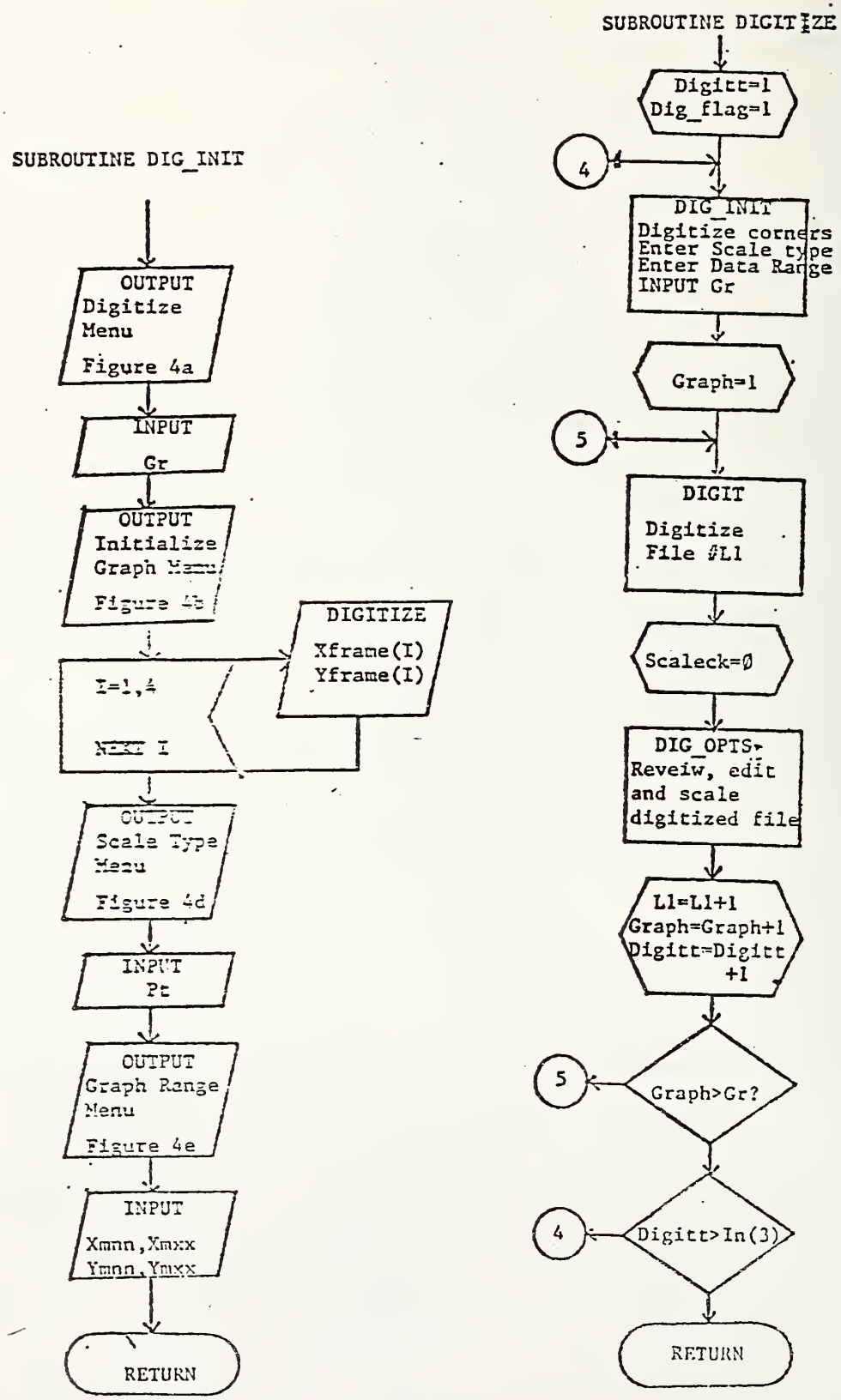
INPUT_DATA SUBROUTINE

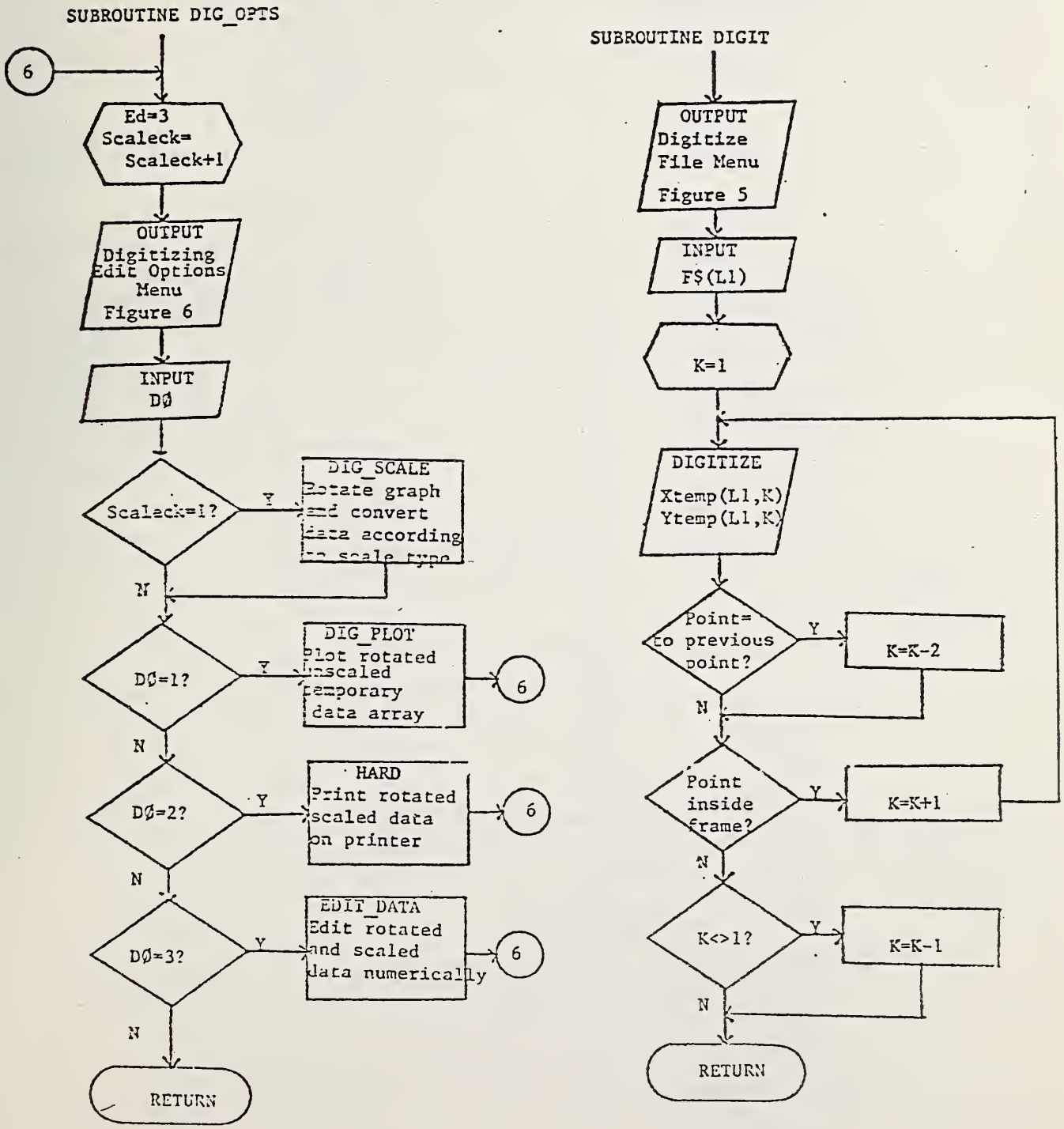



SUBROUTINE KEYBOARD
Key=1
1
OUTPUT
Keyboard
Input Menu
Figure 3a-c
INPUT
F$(L1)
Npt(L1)
A1
A1=1?
N
Y
OUTPUT
Figure 3d-e
INPUT
XØ,Dx
INPUT
X1(L1,I),
Y1(L1,I)
I=1,Npt(L1)
NEXT I
COMPUTE
X1(L1,I)=
XØ+(I-1)+Dx
I=1,Npt(L1)
NEXT I
INPUT
Y1(L1,I)
I=1,Npt(L1)
NEXT I
EDIT DATA
Reveiw and
Edit file #L1
L1=L1+1
Key=Key+1
Key
>In(1)?
Y
N
RETURN
1

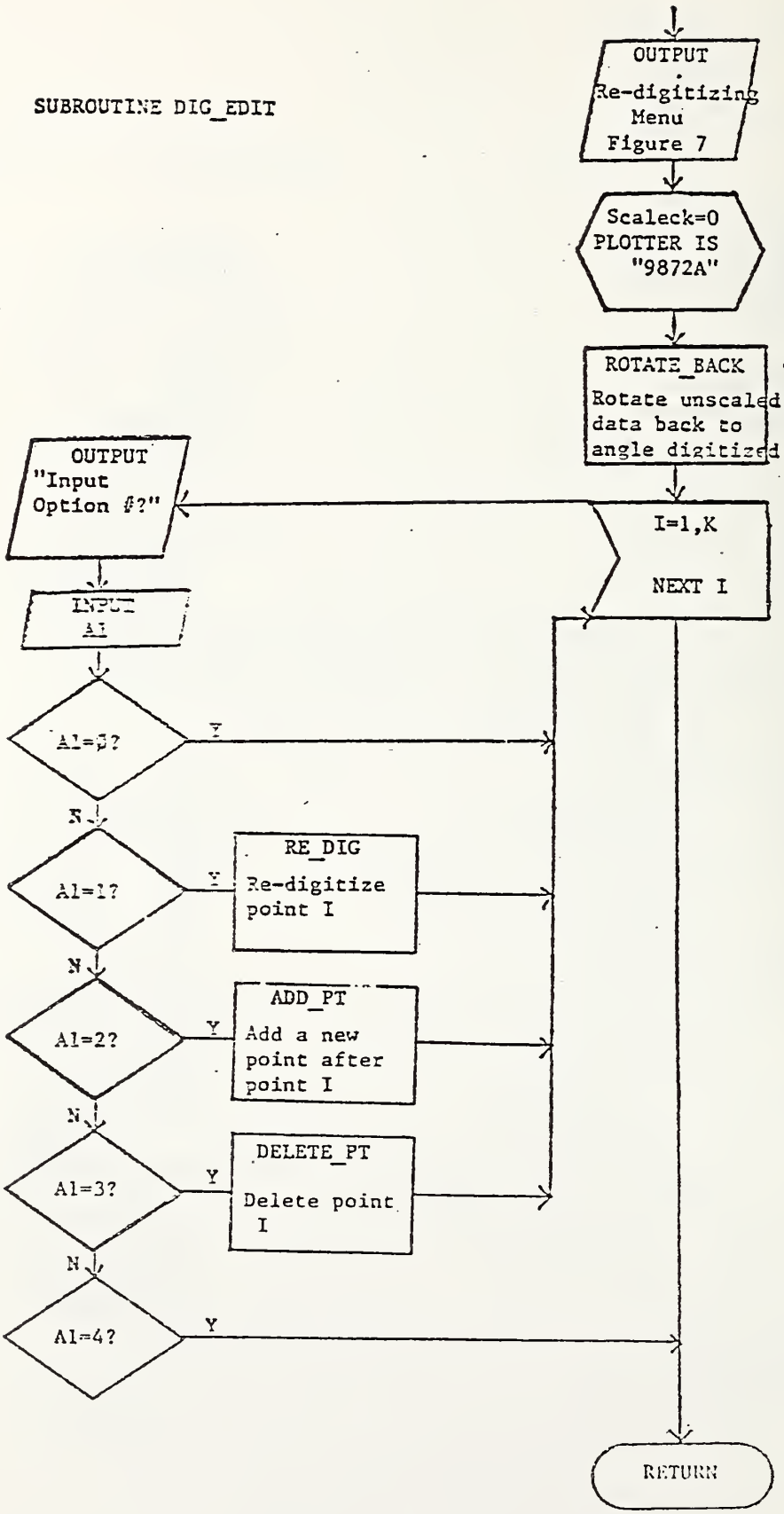
SUBROUTINE TAPE

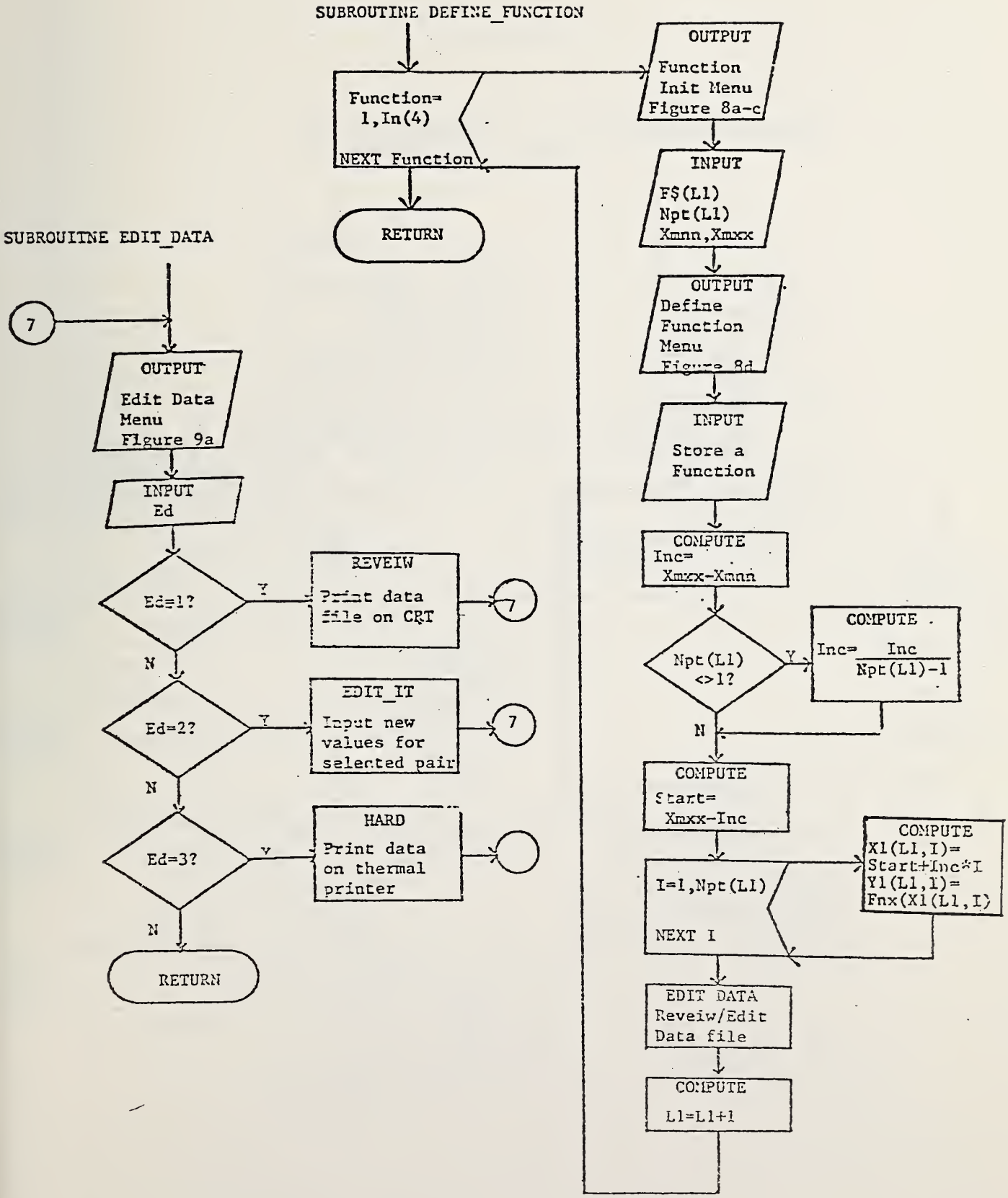



SUBROUTINE DIGITIZE
Digitt=1
Dig_flag=1
4
DIG_INIT
Digitize corners
Enter Scale type
Enter Data Range
INPUT Gr
Graph=1
5
DIGIT
Digitize
File #L1
Scaleck=Ø
DIG_OPTS
Reveiw, edit
and scale
digitized file
L1=L1+1
Graph=Graph+1
Digitt=Digitt
+1
5
Graph>Gr?
4
Digitt>In(3)
RETURN
SUBROUTINE DIG_INIT
OUTPUT
Digitize
Menu
Figure 4a
INPUT
Gr
OUTPUT
Initialize
Graph Menu
Figure 4b
DIGITIZE
Xframe(I)
Yframe(I)
I=1,4
NEXT I
OUTPUT
Scale Type
Menu
Figure 4d
INPUT
Pt
OUTPUT
Graph Range
Menu
Figure 4e
INPUT
Xmnn,Xmxx
Ymnn,Ymxx
RETURN

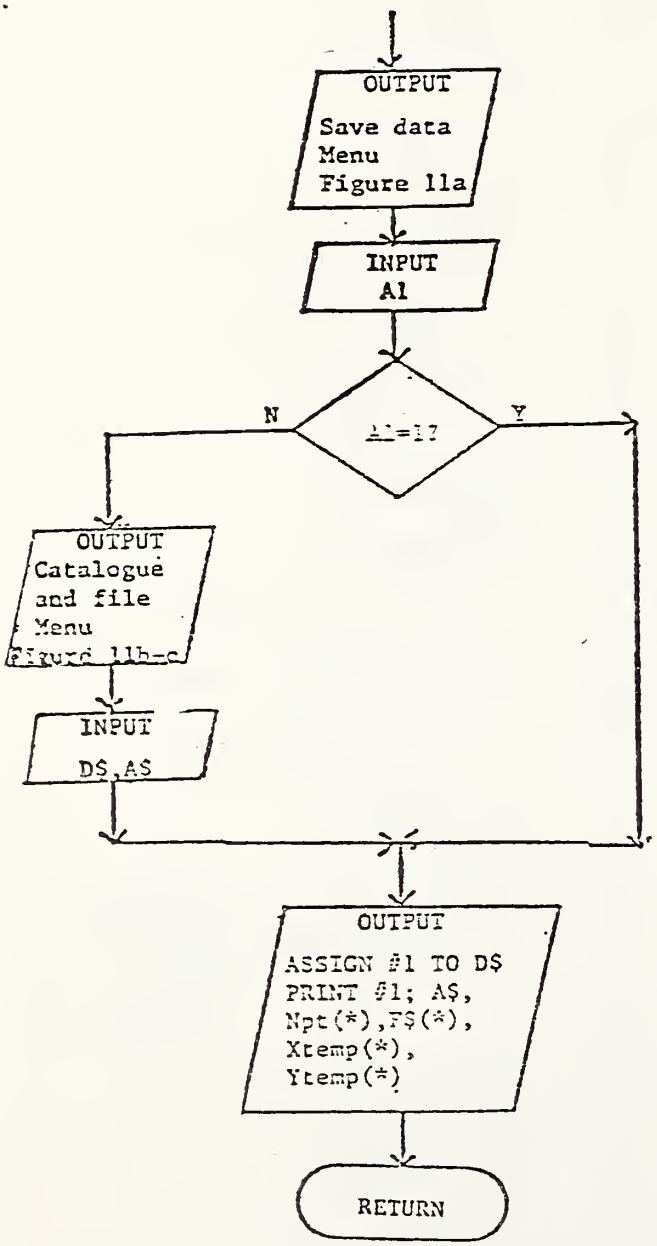

SUBROUTINE DIG_OPTS
6
Ed=3
Scaleck=
Scaleck+1
OUTPUT
Digitizing
Edit Options
Menu
Figure 6
INPUT
DØ
Scaleck=1?
Y
DIG_SCALE
Rotate graph
and convert
data according
to scale type
N
DØ=1?
Y
DIG_PLOT
Plot rotated
unscaled
temporary
data array
6
N
DØ=2?
Y
HARD
Print rotated
scaled data
on printer
6
N
DØ=3?
Y
EDIT_DATA
Edit rotated
and scaled
data numerically
6
N
RETURN
SUBROUTINE DIGIT
OUTPUT
Digitize
File Menu
Figure 5
INPUT
F$(L1)
K=1
DIGITIZE
Xtemp(L1,K)
Ytemp(L1,K)
Point=
to previous
point?
Y
K=K-2
N
Point
inside
frame?
Y
K=K+1
N
K<>1?
Y
K=K-1
N
RETURN

SUBROUTINE DIG_EDIT

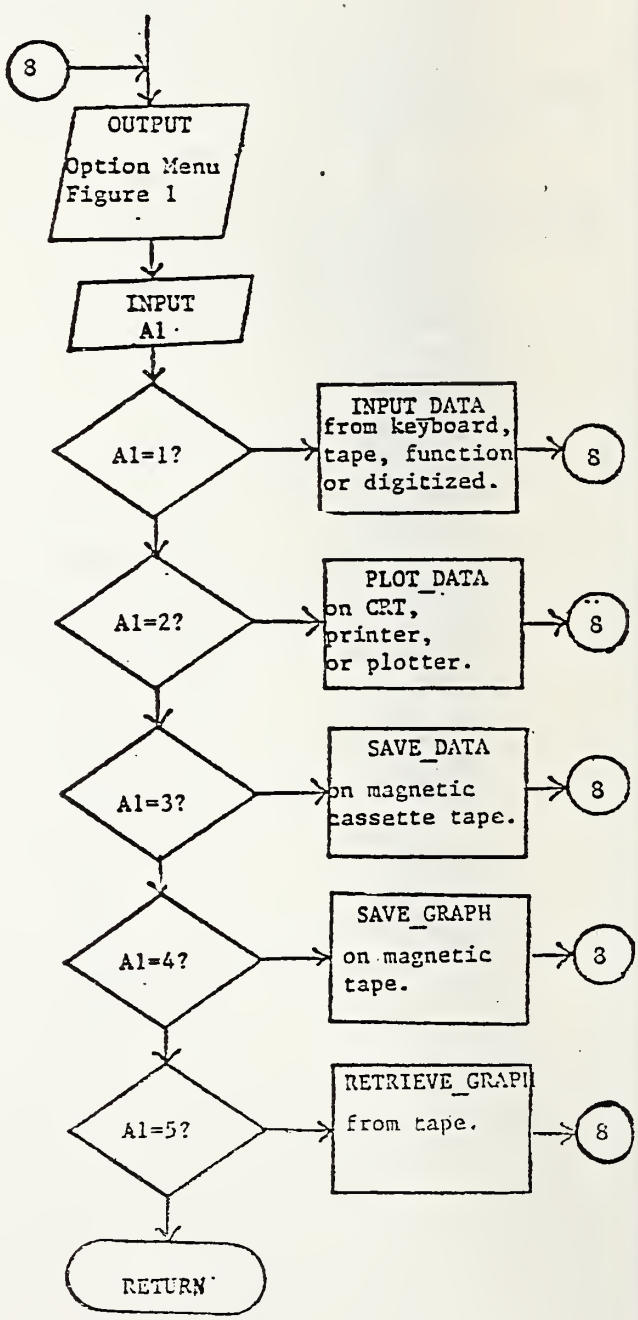



SUBROUTINE DEFINE_FUNCTION
Function= 1,In(4)
NEXT Function
RETURN
OUTPUT
Function Init Menu Figure 8a-c
INPUT
F$(L1)
Npt(L1)
Xmnn,Xmxx
OUTPUT
Define Function Menu Figure 8d
INPUT
Store a Function
COMPUTE
Inc= Xmxx-Xmnn
Npt(L1) <>1?
Y
N
COMPUTE
Inc= Inc / Npt(L1)-1
COMPUTE
Start= Xmxx-Inc
I=1,Npt(L1)
NEXT I
COMPUTE
X1(L1,I)= Start+Inc*I
Y1(L1,I)= Fnx(X1(L1,I)
EDIT DATA
Reveiw/Edit Data file
COMPUTE
L1=L1+1
SUBROUITNE EDIT_DATA
7
OUTPUT
Edit Data Menu Figure 9a
INPUT
Ed
Ed=1?
REVEIW
Print data file on CRT
Ed=2?
EDIT_IT
Input new values for selected pair
Ed=3?
HARD
Print data on thermal printer
RETURN

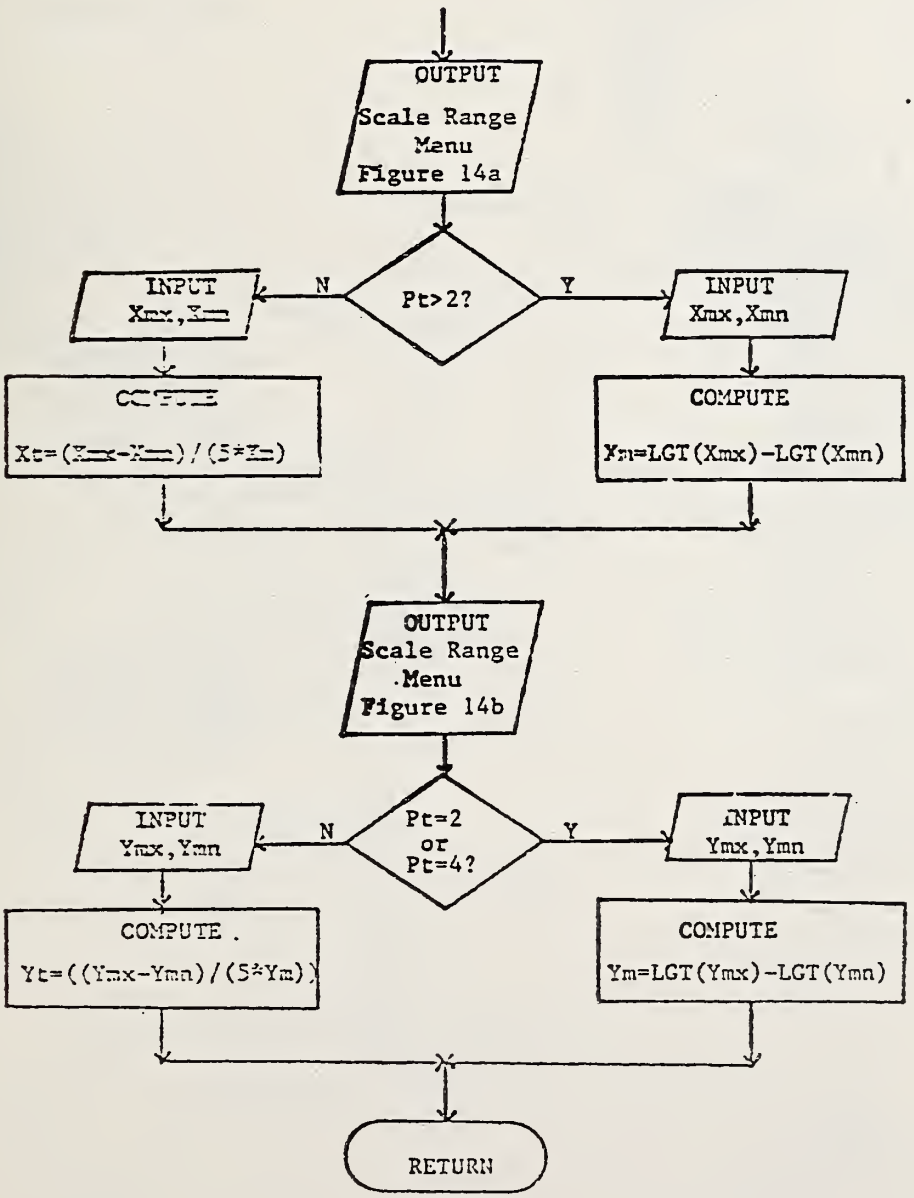
SUBROUTINE SAVE_DATA

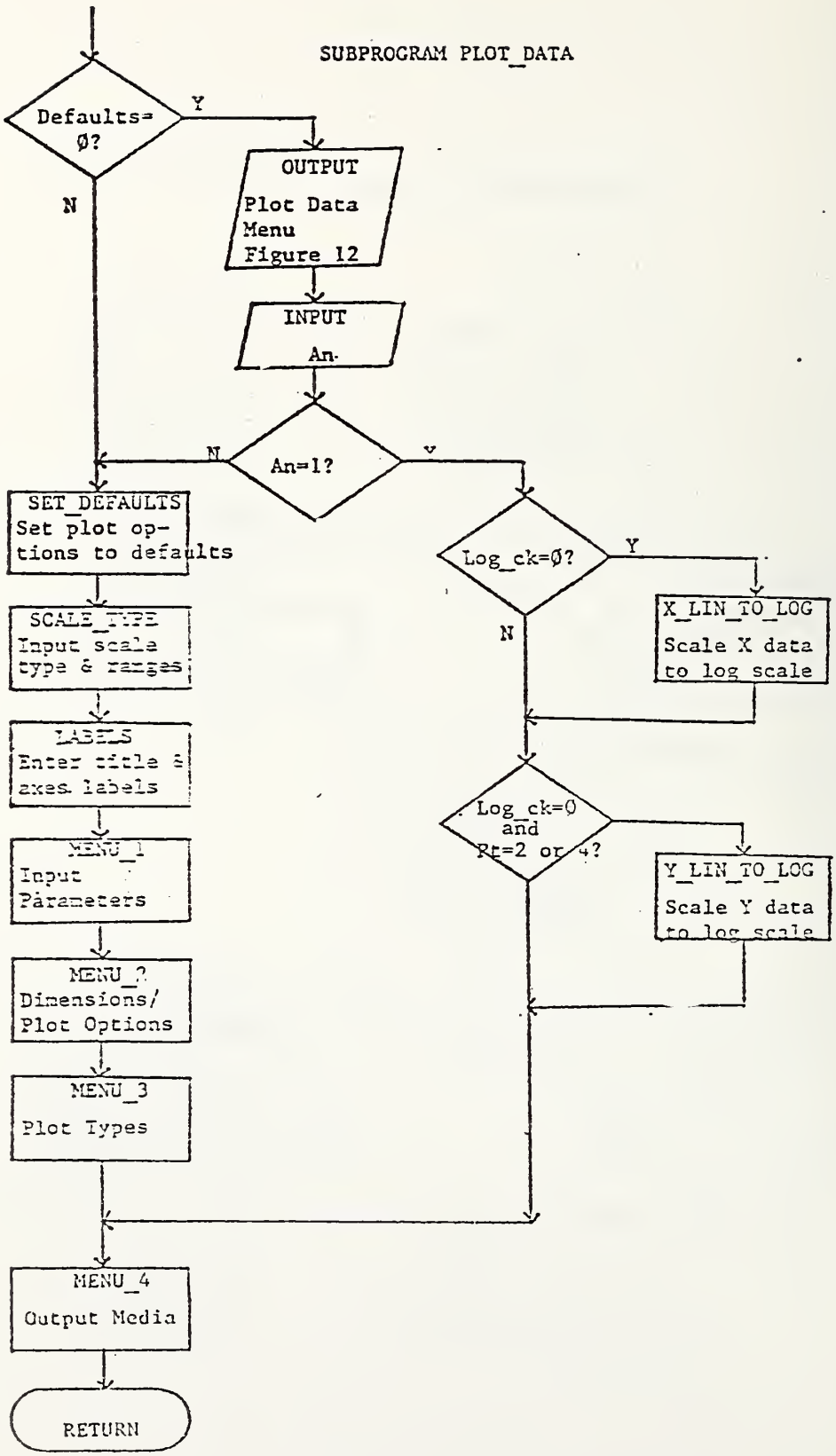


SUBROUTINE OPTIONS

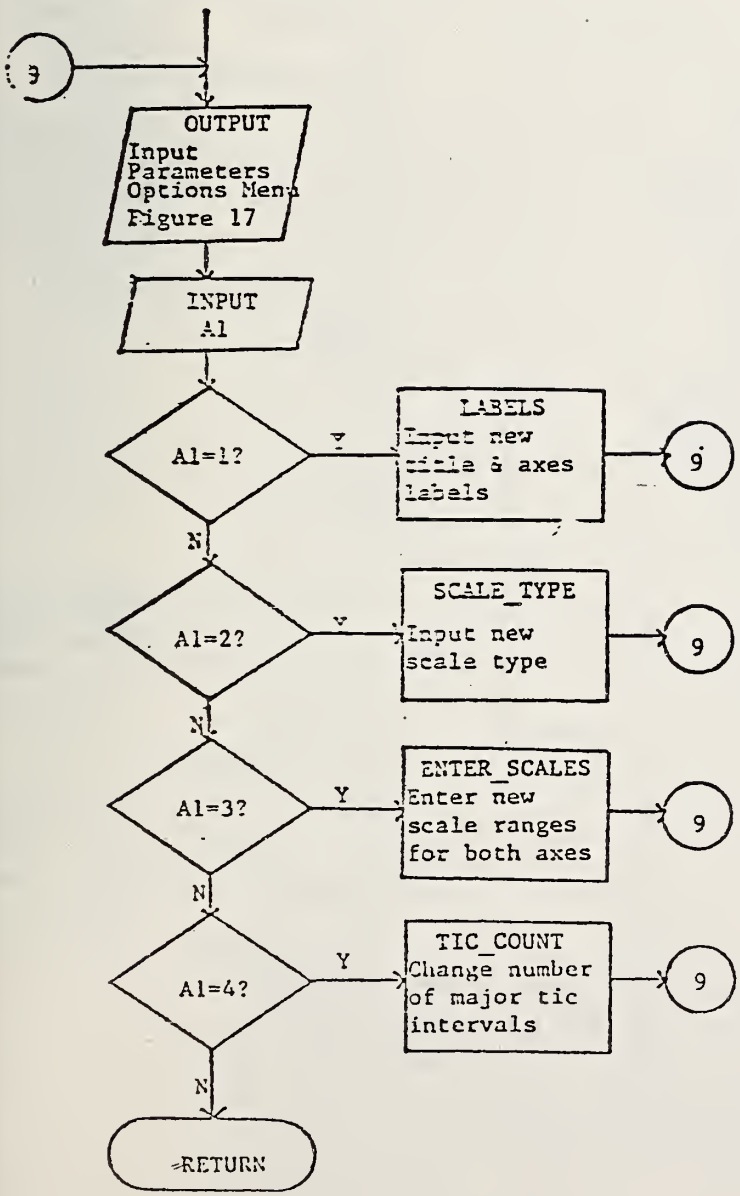


SUBROUITNE ENTER SCALES

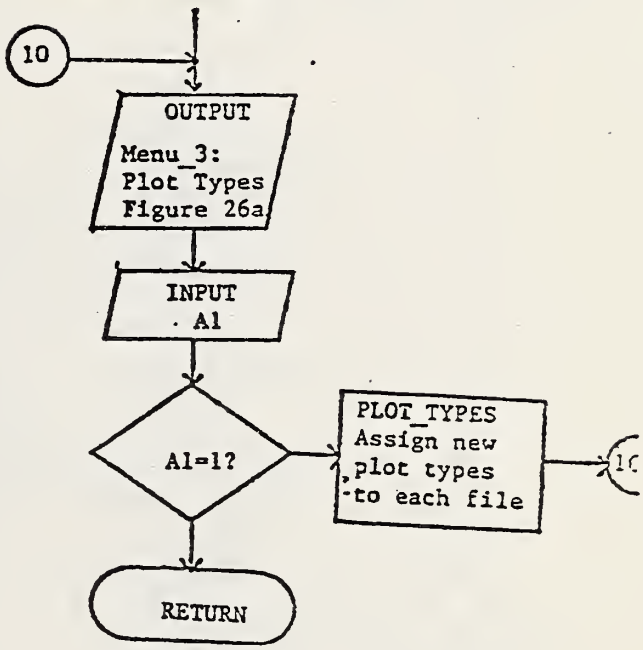


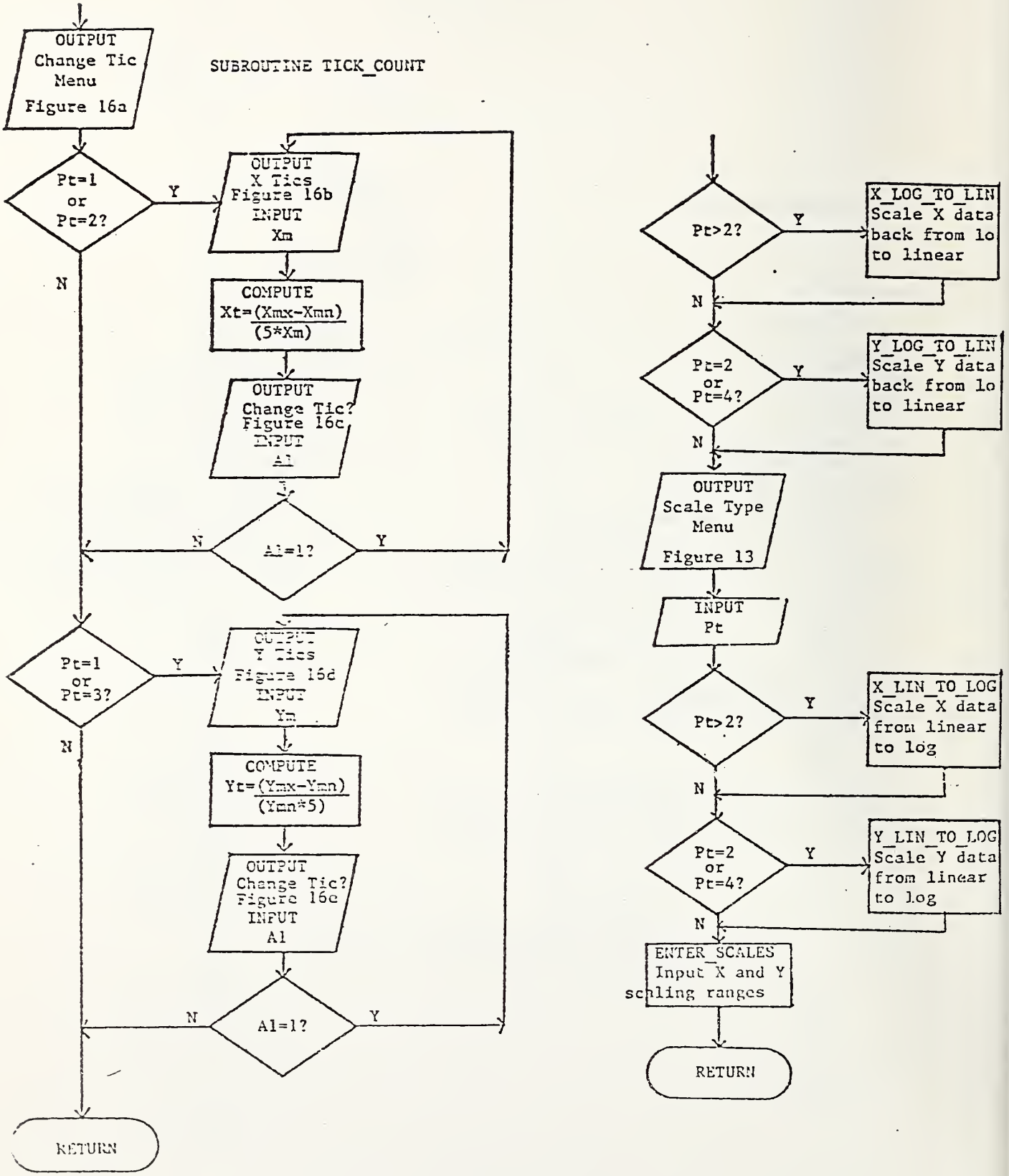

SUBPROGRAM PLOT_DATA
Defaults= Ø?
Y
N
OUTPUT
Plot Data Menu
Figure 12
INPUT
An
An=1?
N
Y
SET_DEFAULTS
Set plot options to defaults
SCALE_TYPE
Input scale type & ranges
LABELS
Enter title & axes labels
MENU_1
Input Parameters
MENU_2
Dimensions/ Plot Options
MENU_3
Plot Types
Log_ck=Ø?
Y
N
X_LIN_TO_LOG
Scale X data to log scale
Log_ck=0 and Pt=2 or 4?
Y_LIN_TO_LOG
Scale Y data to log scale
MENU_4
Output Media
RETURN

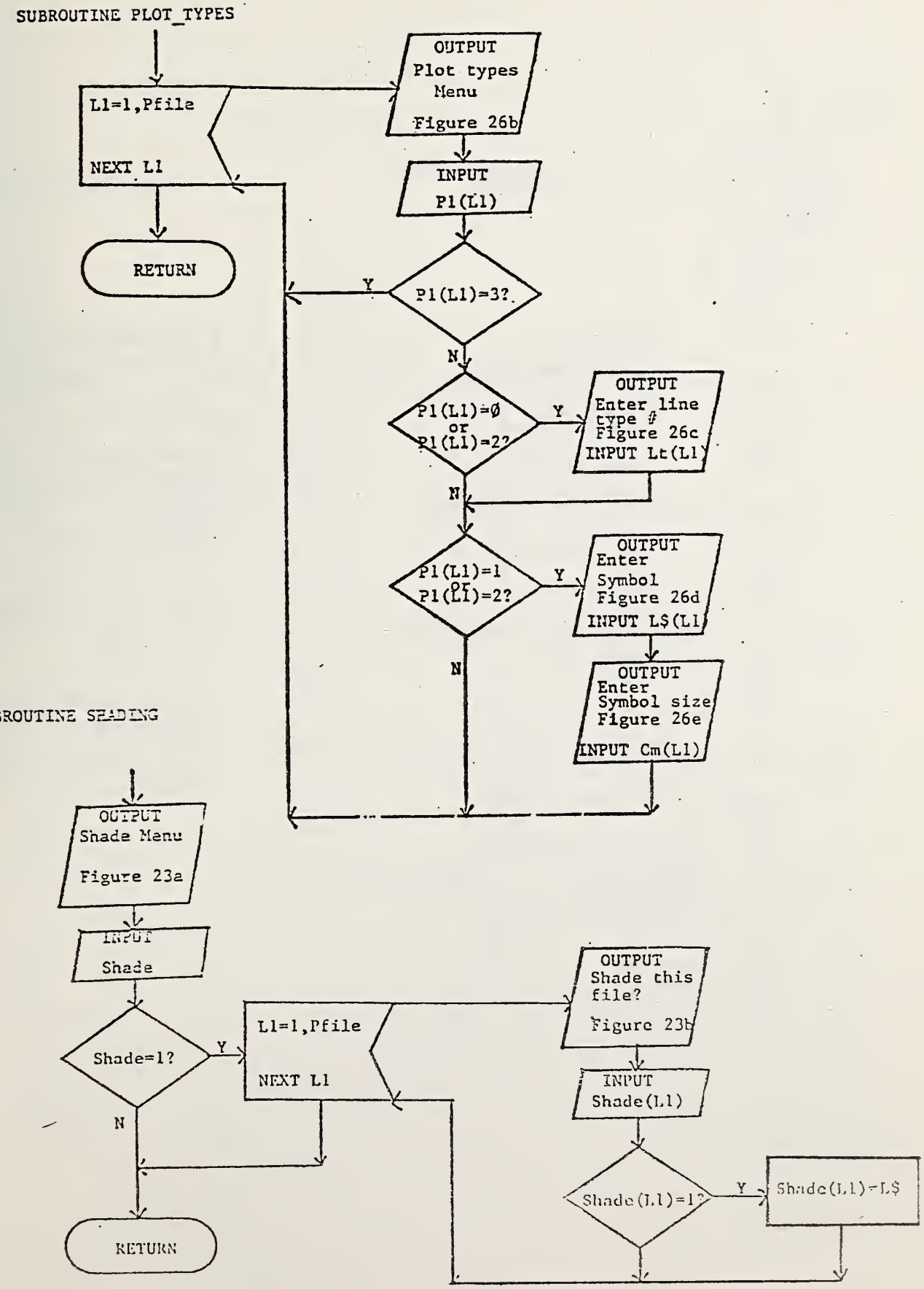
SUBROUTINE MENU_1



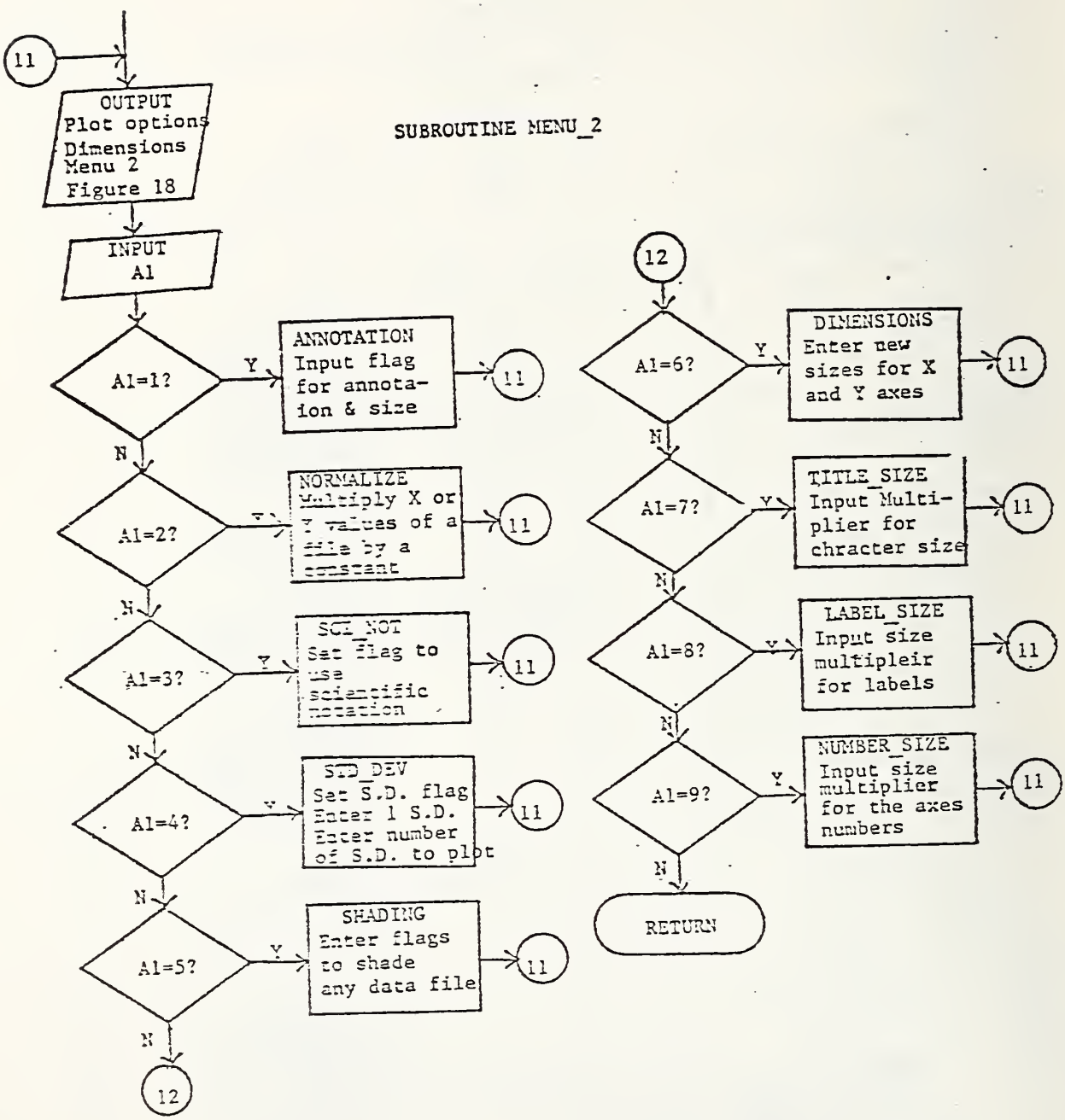
SUBROUTINE MENU_3



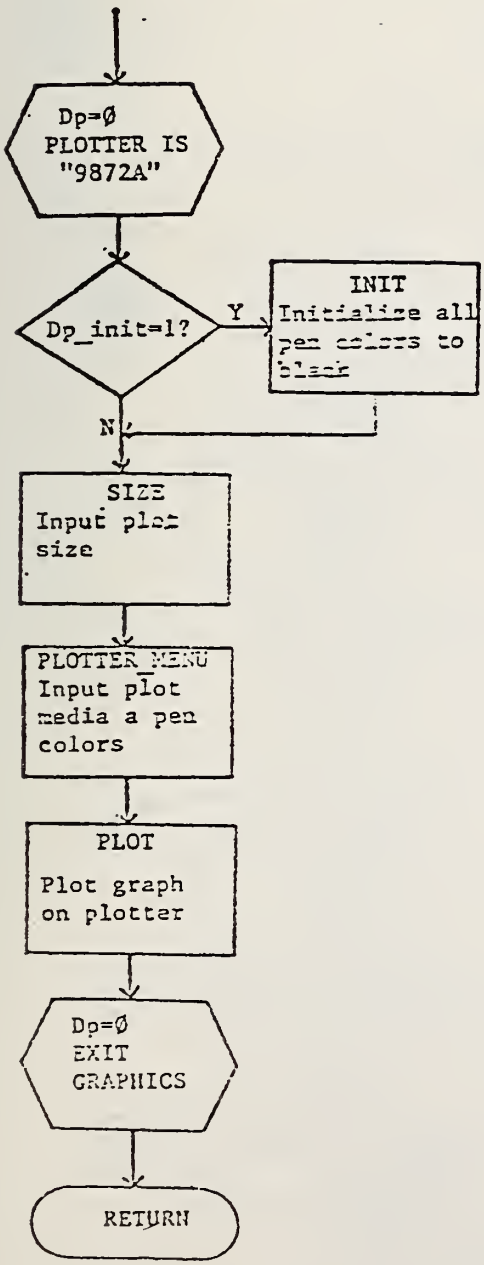

SUBROUTINE TICK_COUNT
OUTPUT Change Tic Menu Figure 16a
Pt=1 or Pt=2?
Y
N
OUTPUT X Tics Figure 16b INPUT Xm
COMPUTE Xt=(Xmx-Xmn)/(5*Xm)
OUTPUT Change Tic? Figure 16c INPUT A1
A1=1?
N
Y
Pt=1 or Pt=3?
Y
N
OUTPUT Y Tics Figure 16d INPUT Ym
COMPUTE Yt=(Ymx-Ymn)/(Ymn*5)
OUTPUT Change Tic? Figure 16e INPUT A1
A1=1?
N
Y
RETURN
Pt>2?
Y
N
X_LOG_TO_LIN Scale X data back from lo to linear
Pt=2 or Pt=4?
Y
N
Y_LOG_TO_LIN Scale Y data back from lo to linear
OUTPUT Scale Type Menu Figure 13
INPUT Pt
Pt>2?
Y
N
X_LIN_TO_LOG Scale X data from linear to log
Pt=2 or Pt=4?
Y
N
Y_LIN_TO_LOG Scale Y data from linear to log
ENTER_SCALES Input X and Y scaling ranges
RETURN


SUBROUTINE PLOT_TYPES
L1=1,Pfile
NEXT L1
RETURN
OUTPUT
Plot types
Menu
Figure 26b
INPUT
P1(L1)
P1(L1)=3?
Y
N
P1(L1)=0
or
P1(L1)=2?
Y
OUTPUT
Enter line
type #
Figure 26c
INPUT Lt(L1)
N
P1(L1)=1
or
P1(L1)=2?
Y
OUTPUT
Enter
Symbol
Figure 26d
INPUT L$(L1)
N
OUTPUT
Enter
Symbol size
Figure 26e
INPUT Cm(L1)
SUBROUTINE SHADING
OUTPUT
Shade Menu
Figure 23a
INPUT
Shade
Shade=1?
Y
N
L1=1,Pfile
NEXT L1
OUTPUT
Shade this
file?
Figure 23b
INPUT
Shade(L1)
Shade(L1)=1?
Y
Shade(L1)=L$
RETURN

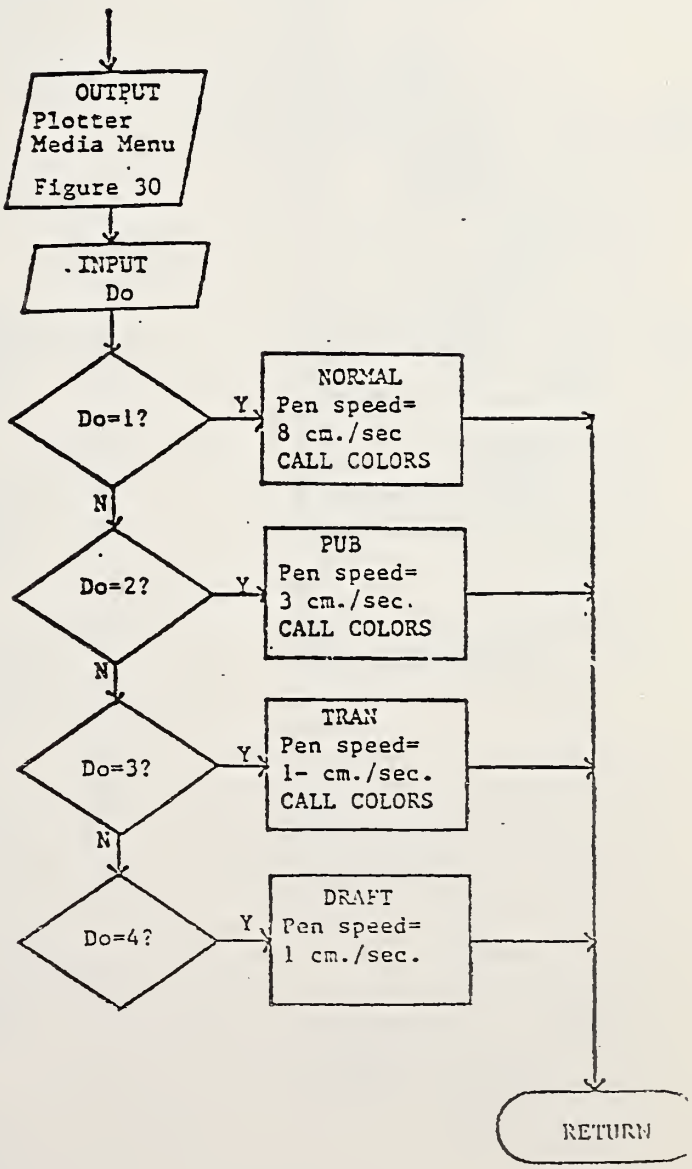
SUBROUTINE MENU_2



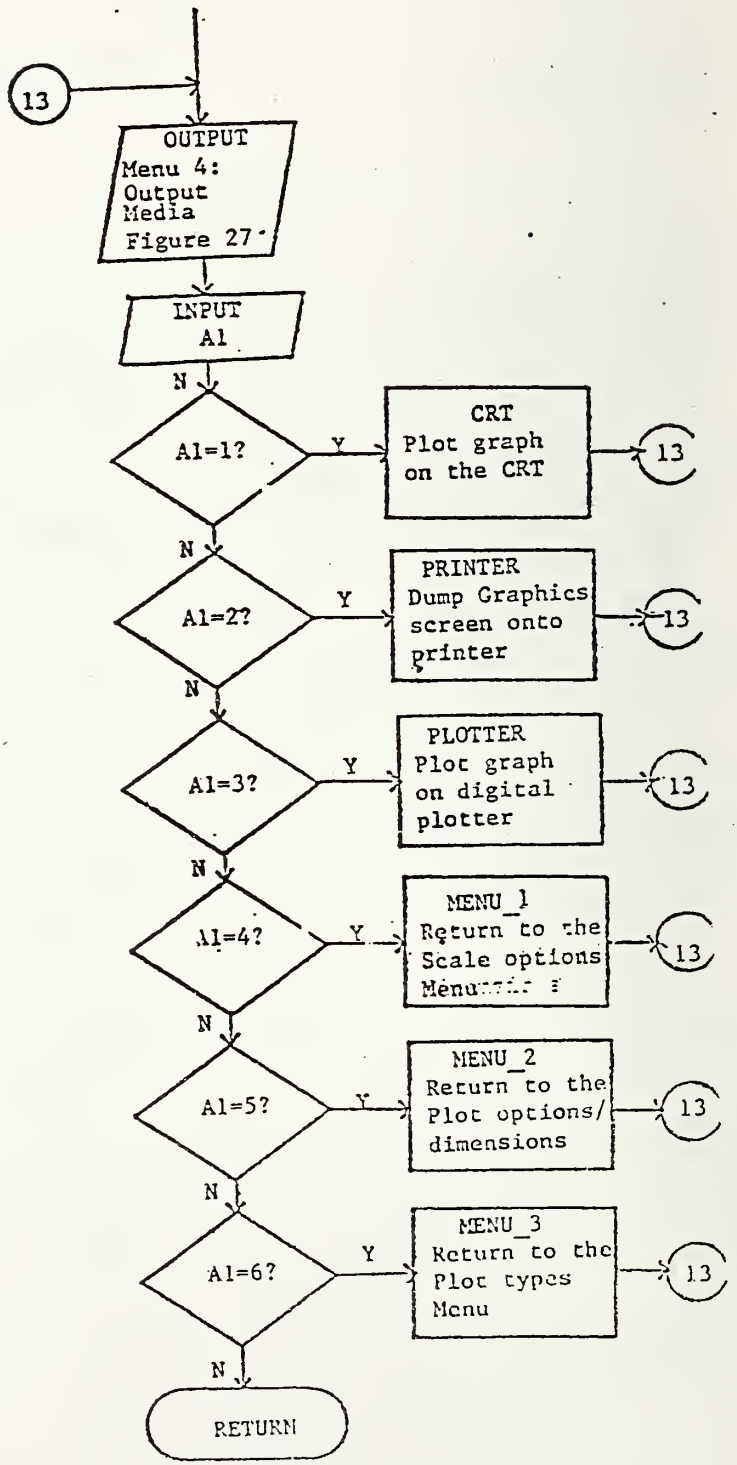
SUBROUTINE PLOTTER



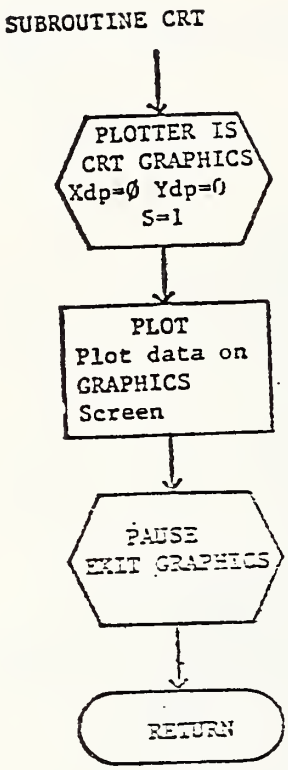
SUBROUTINE PLOTTER_MENU



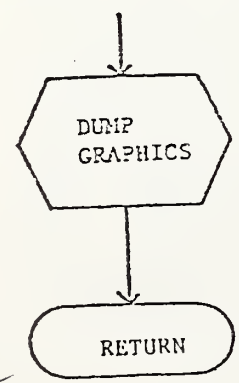
SUBROUTINE MENU 4



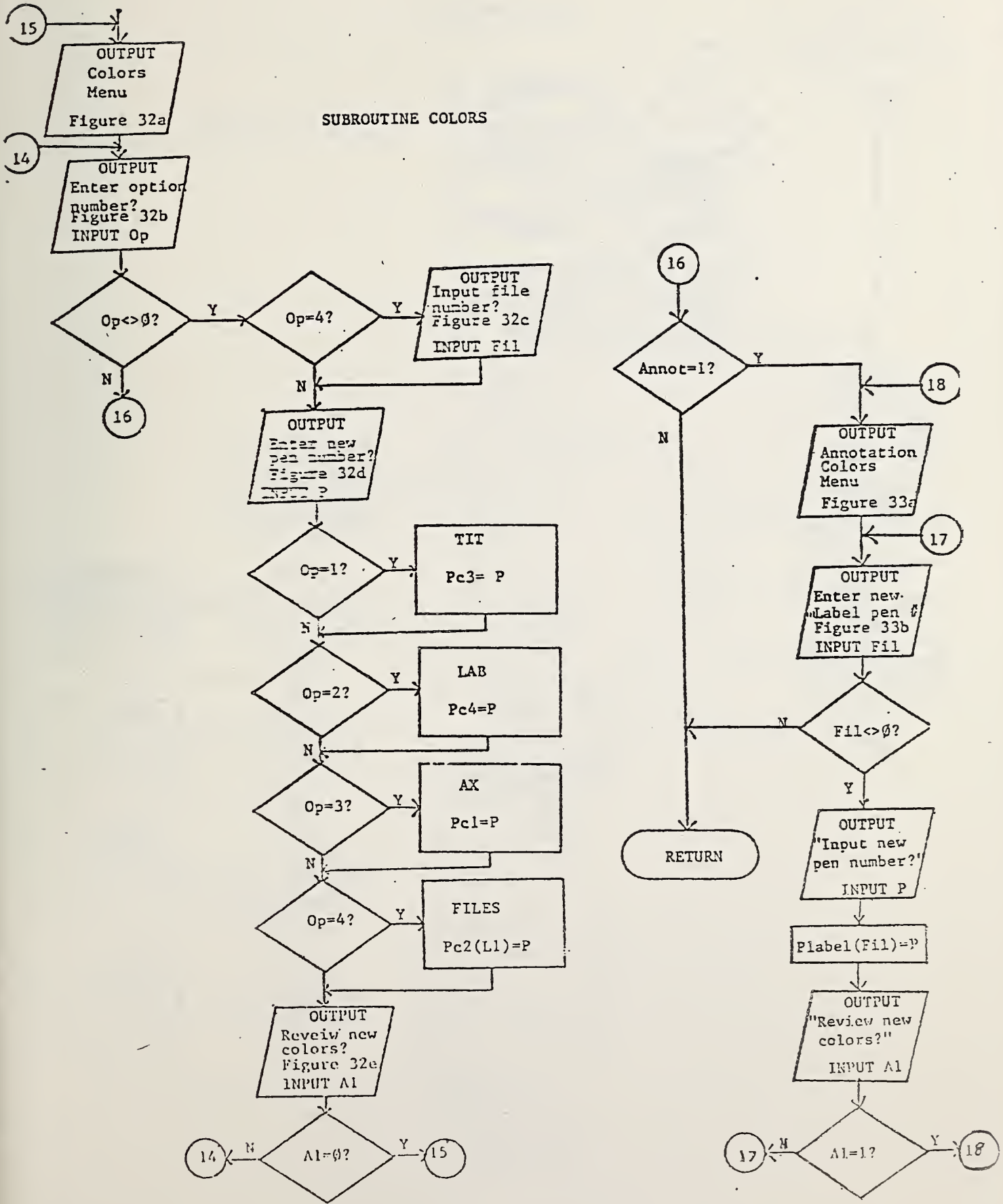
SUBROUTINE CRT



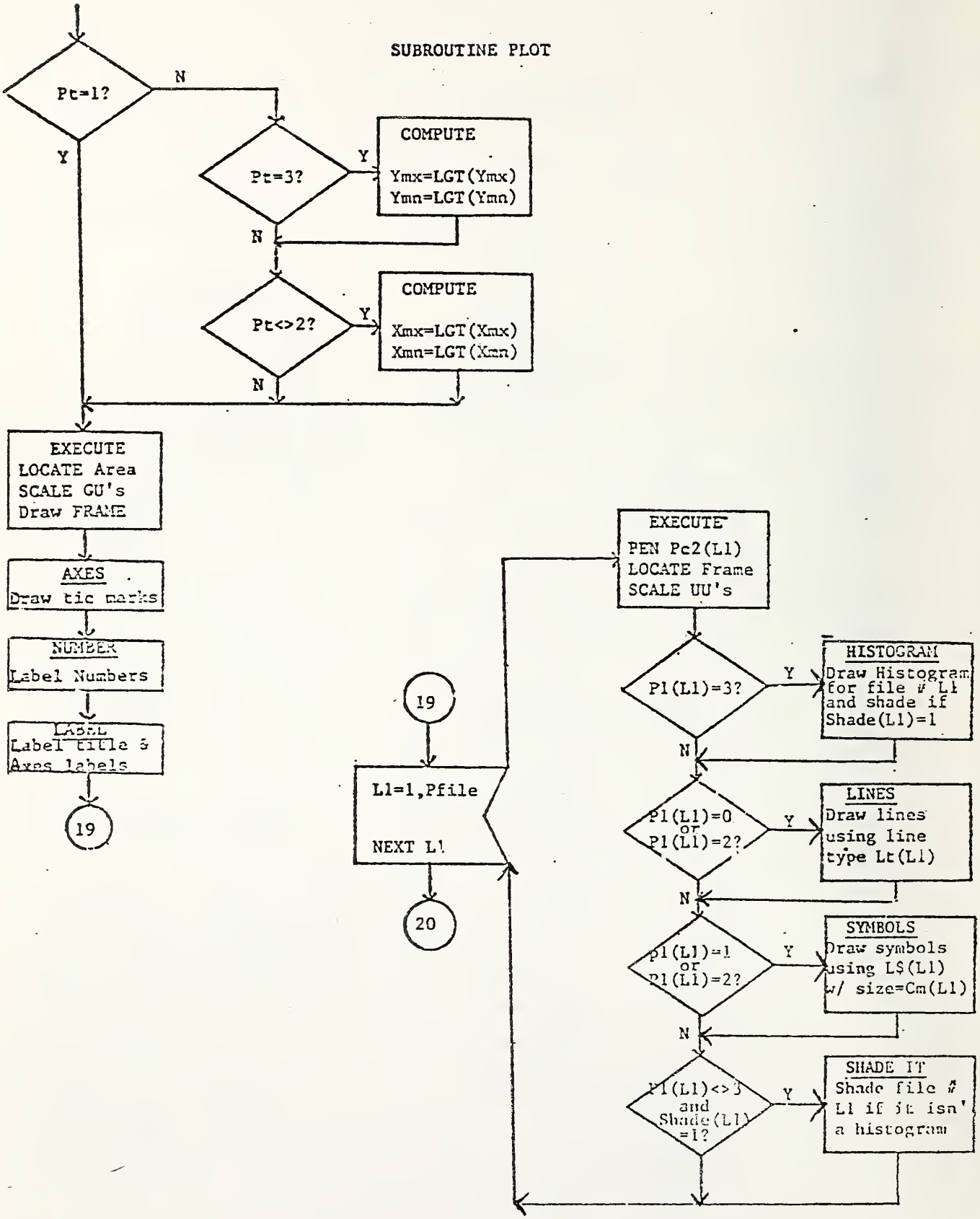
SUBROUTINE PRINTER



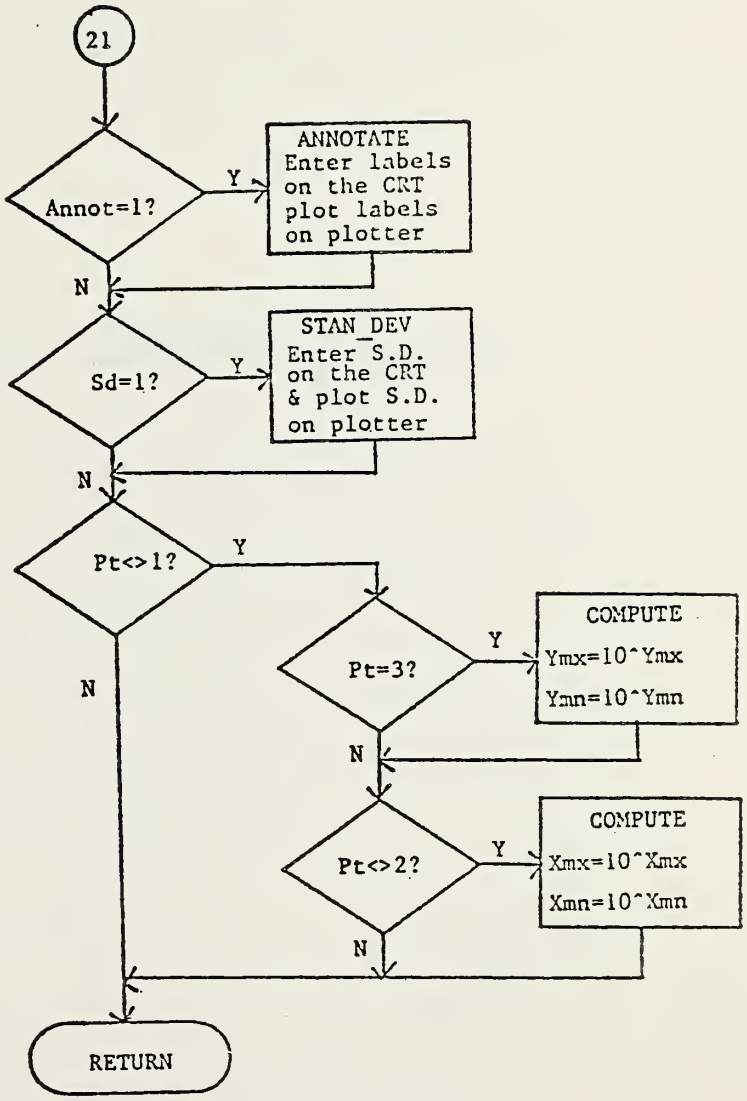
SUBROUTINE COLORS



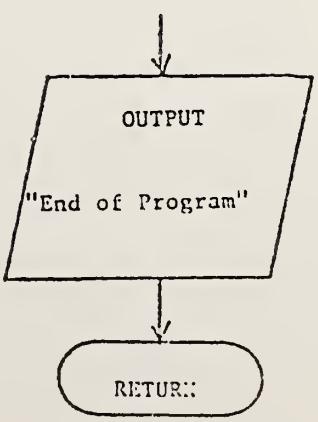
SUBROUTINE PLOT



SUBROUTINE PLOT cont.



SUBROUTINE END_IT



APPENDIX E: INDEX OF FIGURES, FLOWCHARTS AND SUBROUTINES

APPENDIX E: INDEX TO MENU, LISTING AND FLOWCHART FIGURES

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APPENDIX F: OUTPUT EXAMPLES

APPENDIX F: OUTPUT EXAMPLES

Appendix F contains examples of the plotting options available. Listed below are the examples and the plot options that are used in the order that they appear using the materials recommended in Appendix A.

VARIABLE ENERGY
1) Thin tipped felt tip pens used on cotton drawing paper.
2) Multiple data files using line types 1,4,6,8 and symbols #,&,*, and +.
3) Scientific notation.
4) Standard deviation.
5) Graph dimensions 60x80 graphic units.
6) Plot size .65.
7) Five major tics on the Y axis, four major tics on the X axis.

MONTE CARLO LINE PROFILE
1) Shading using wide tip pen.
2) Annotation.
3) Y values normalized by 1000.
4) Data input from keyboard.

PZT5A
1) Drafting pen on vellum.
2) Data digitized off plotter from experimental curve.
3) Dimensions 80x80, plot size .5, graph ends up 4"x4".

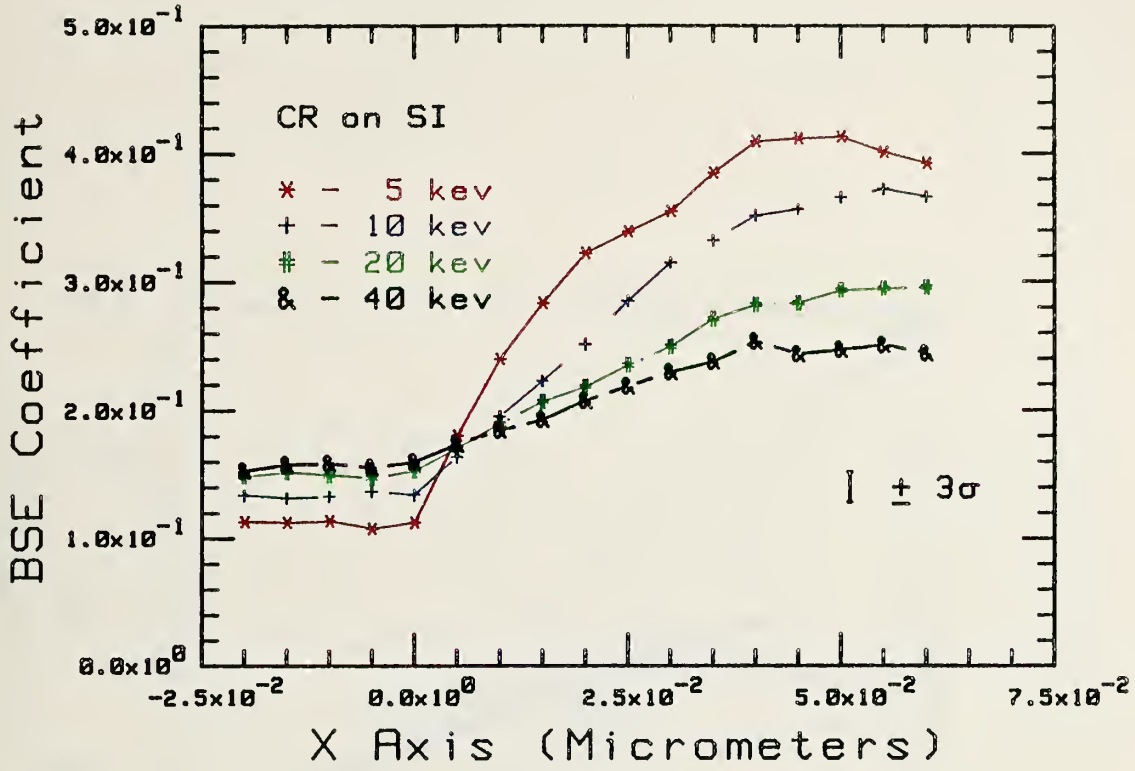
RELATIVE AREA
1) No frame, tics, numbers, title, or axes labels.
2) Picture digitized from a hand drawing.
3) Numbers and title have been input using the annotation option.

BA 100EV
1) HP transparency film using the HP transparency thin tipped pens.
2) Logarithmic scale on the Y axis.
3) Annotation used for the Figure caption.

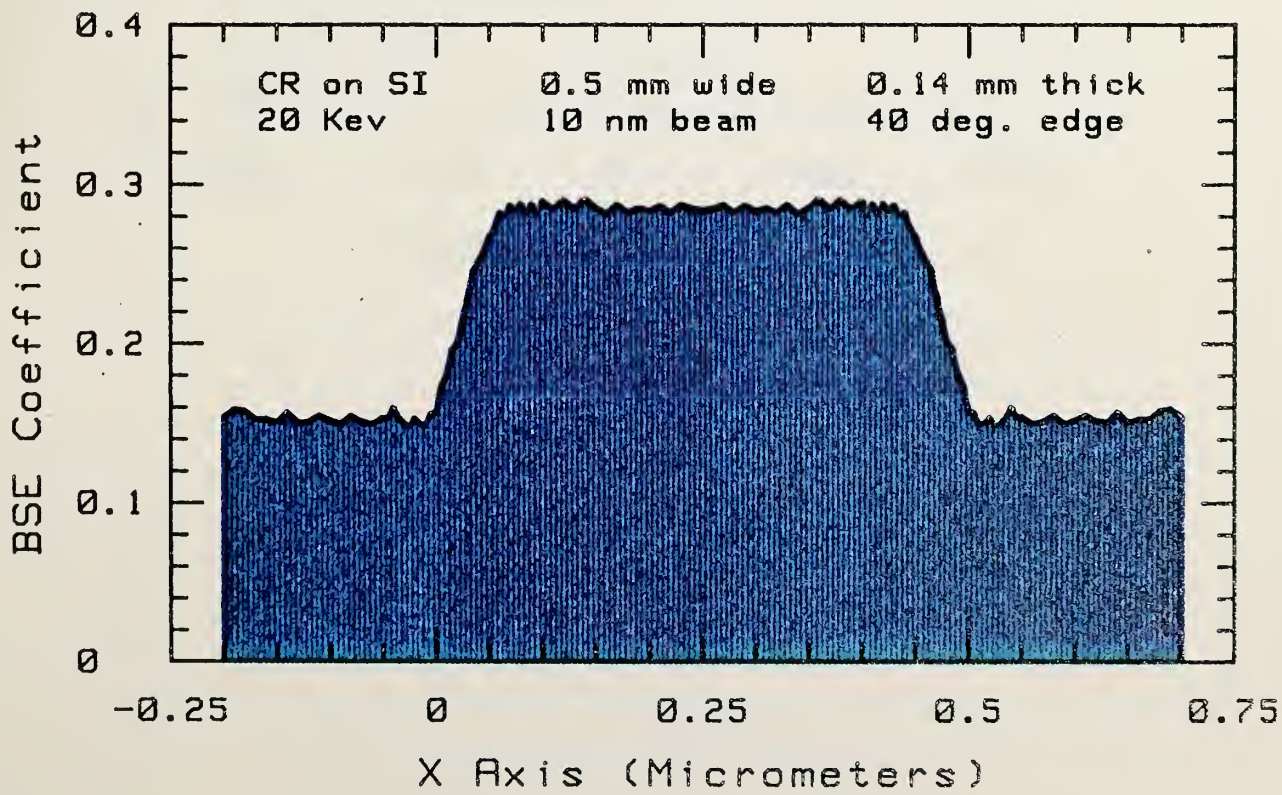
SPECTRUM SINE WAVE
1) HP spectrum paper and pens.
2) Fourteen distinguishable colors using up color combinations of up to three colors.
3) Sine waves input from the Define Function mode using 36 sine waves with amplitudes ranging from 17 to 2 and X data range of 0 to 360.

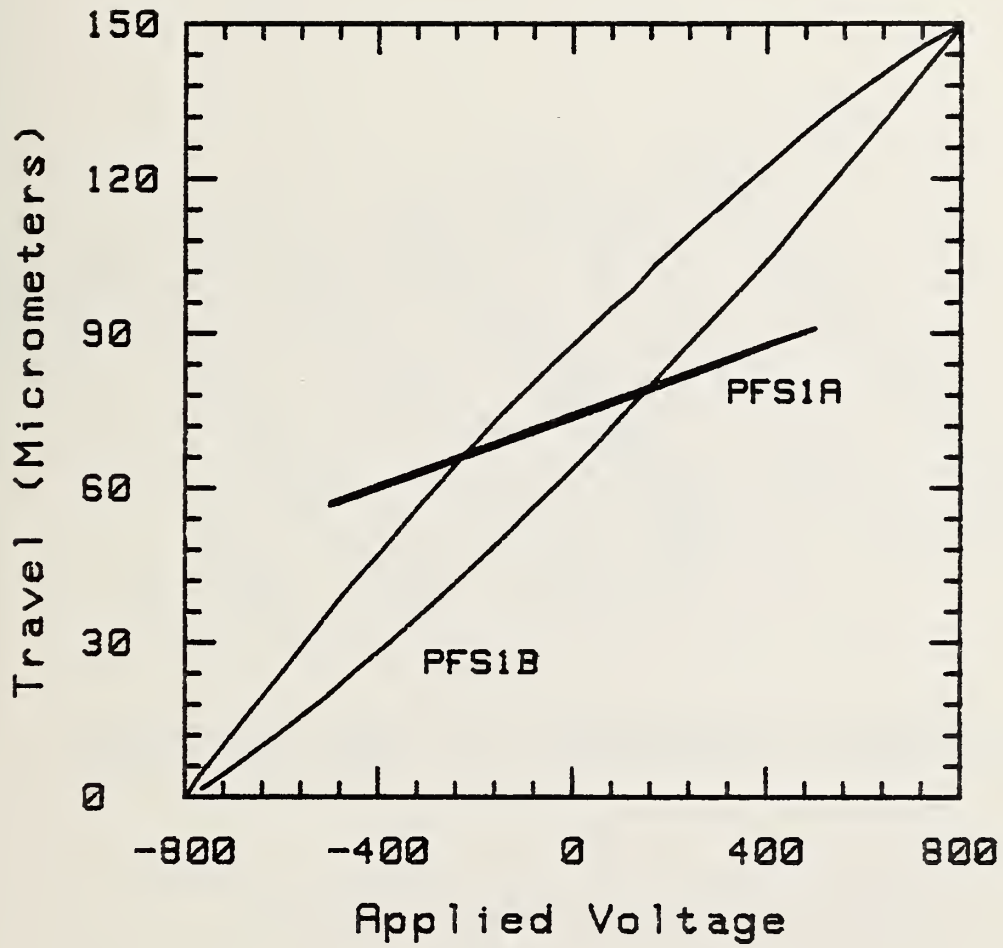
HARDWARE PRODUCTION COMPANY
1) Histogram plots for three data files.
2) Histograms are shaded.
3) Spectrum pens were used. Overwriting the first data file (magenta) by the second (yellow), created the green color for nails. Overwriting with the third file (cyan) created the purple color for bolts.
4) The lines in the key were digitized after the histogram graph was completed.
5) Notice the ten major tics on the Y axis.

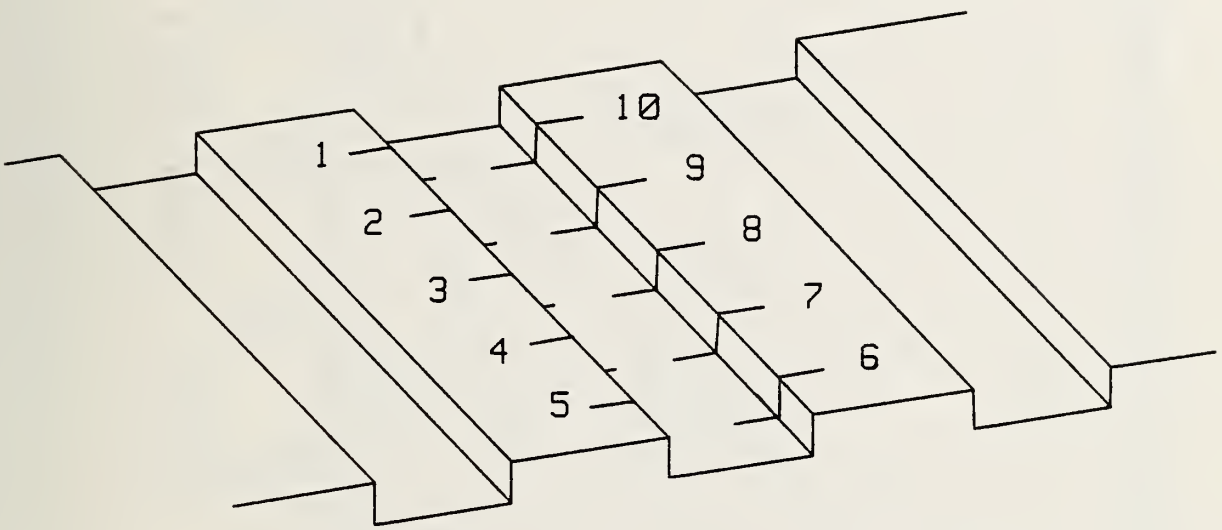
VARIABLE ENERGY



MONTE CARLO LINE PROFILE




150
120
90
60
30
0
Travel (Micrometers)
PFS1A
PFS1B
-800
-400
0
400
800
Applied Voltage



RELATIVE AREA OF MEASUREMENT POSITIONS

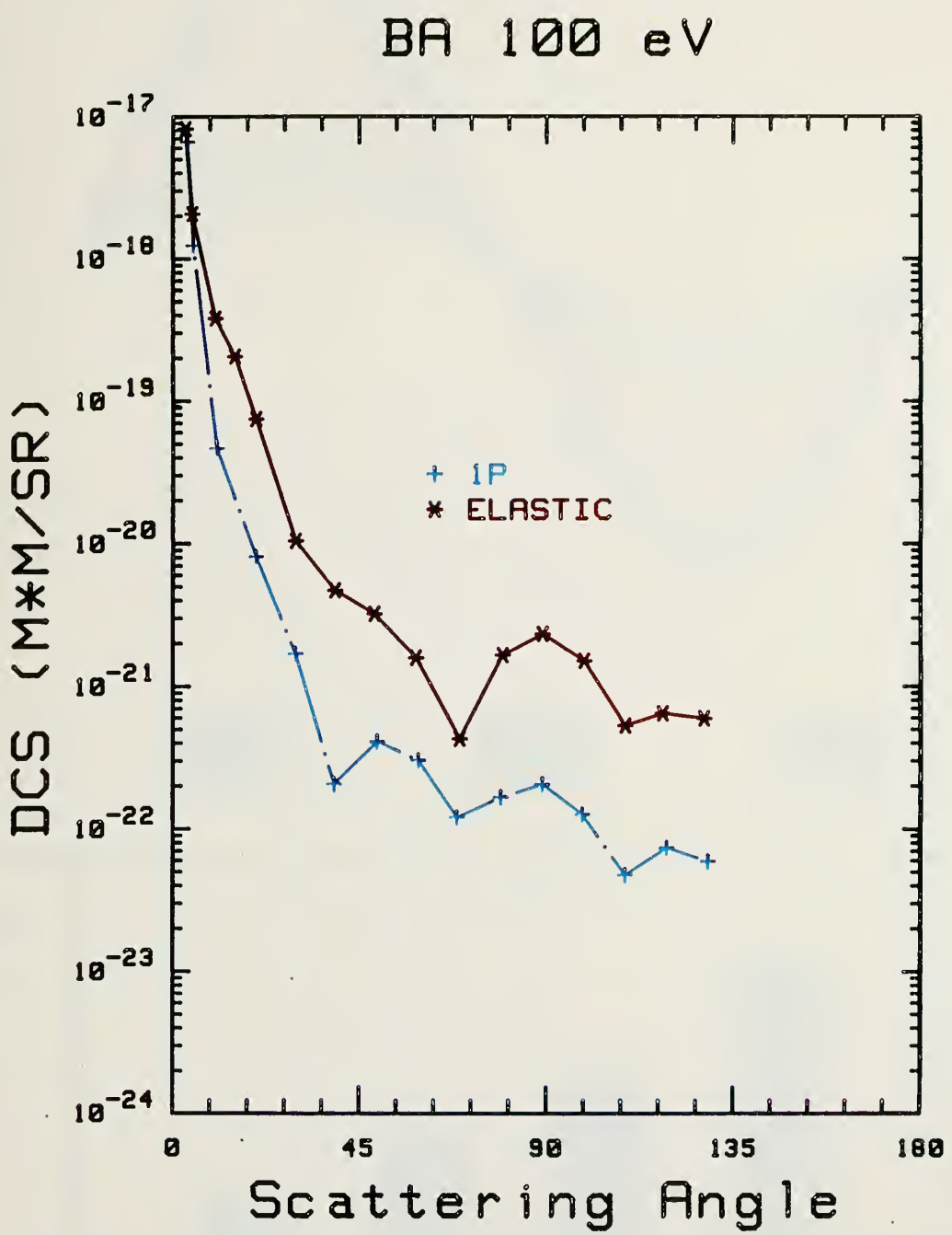
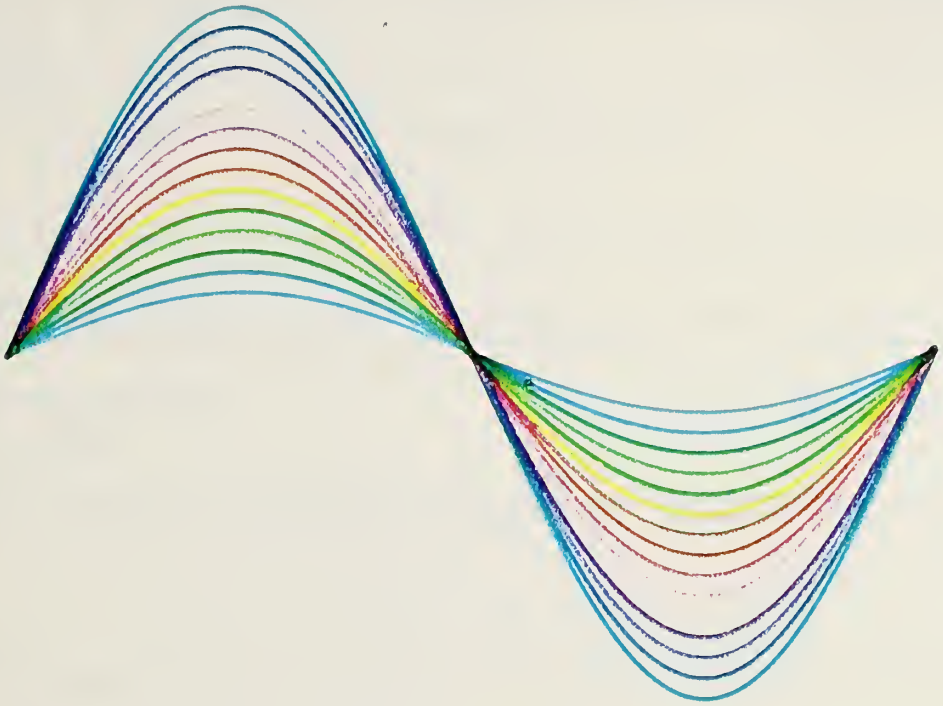
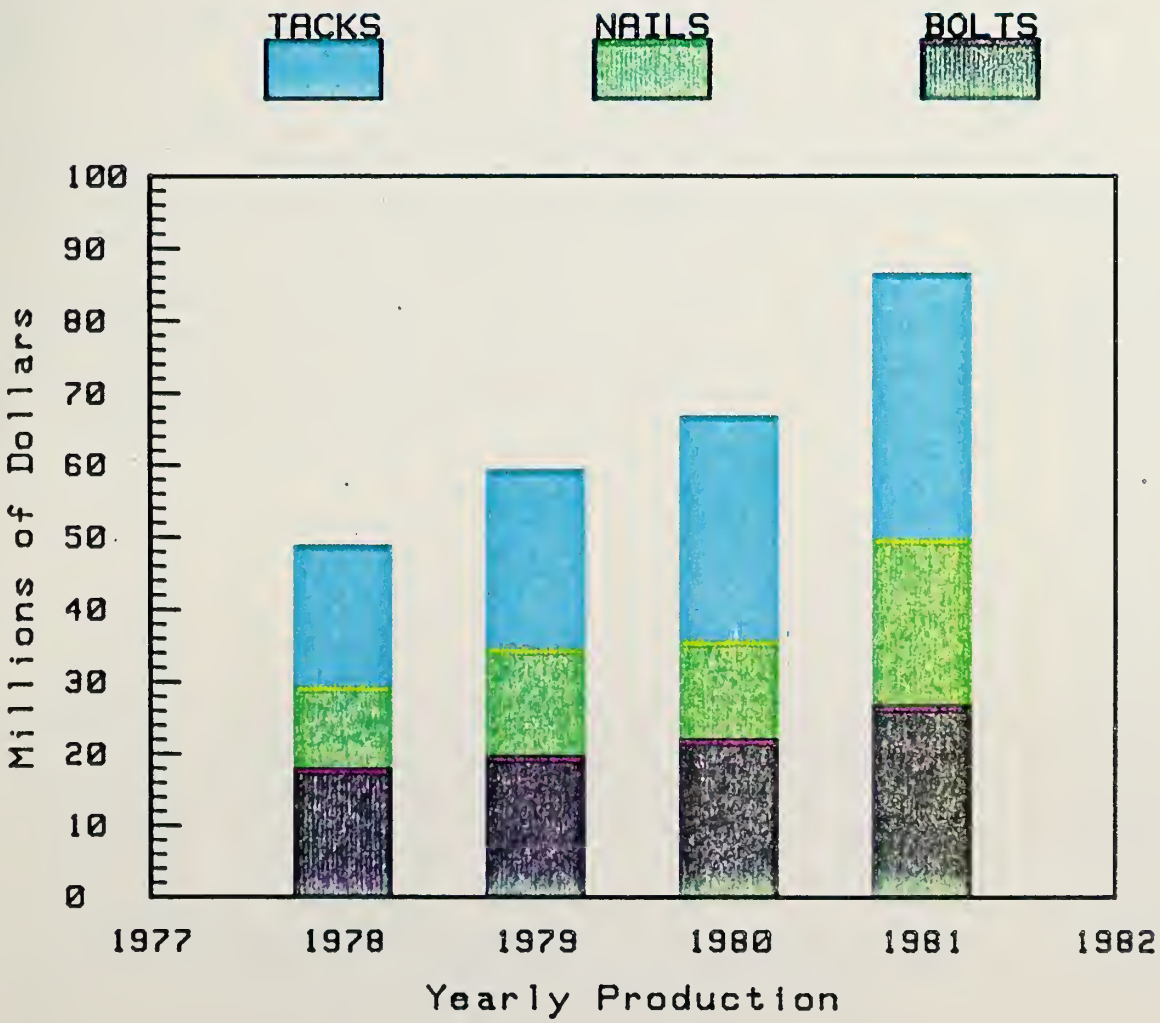


Figure 5-9 Differential cross sections for electron impact on barium at 100 eV.




TACKS
NAILS
BOLTS
100
90
80
70
60
50
40
30
20
10
0
Millions of Dollars
1977
1978
1979
1980
1981
1982
Yearly Production

NBS-114A (REV. 2-8C)

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5. AUTHOR(S)

Clare Y. Trahan and Stephen W. Jensen

6. PERFORMING ORGANIZATION *(If joint or other than NBS, see instructions)*

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DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

7. Contract/Grant No.

8. Type of Report & Period Covered

9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS *(Street, City, State, ZIP)*

10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)*

This report describes an interactive BASIC language graphics utility program designed to facilitate easy plotting of X,Y data. The program operates on a Hewlett-Packard 9845B desktop computer, in its standard configuration, and uses a Hewlett-Packard 9872 A four pen digital plotter. The program allows the user to view X,Y data graphically, and provides a broad range of plotting options so that publication quality graphs and transparencies may be created using up to four colors on the digital plotter. Data may be digitized from a user's graph on the digital plotter, generated as a user defined function, or input directly from the computer keyboard or magnetic tape cassette. Data may be plotted on the computer CRT, on the computer's internal thermal printer, or on the digital plotter.

12. KEY WORDS *(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)*

BASIC; CRT; digital plotter; graphs; HP 9845B desktop computer; interactive; internal thermal printer; magnetic cassette tape; plot; software; X,Y data

13. AVAILABILITY

☒ Unlimited

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☒ Order From National Technical Information Service (NTIS), Springfield, VA. 22161

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